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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 143. NOVEMBER, 1931. PRICE 1s. NET

HAS GLIDING A FUTURE?
(See page 365)

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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XII. No. 143. NOVEMBER, 1931. PRICE 1s. NET

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Notes of the Month.

The discovery of a new element was reported from America a fortnight ago. At the time of writing there is as yet no information as to whether "eka-caesium" has been isolated in weighable or visible quantities, but Dr. Andrade, Quain Professor of Physics in the University of London, thinks that this is unlikely. Discussing the discovery in the *Observer*, he suggests that the element has probably been detected either by the technique known as positive ray analysis or by its radioactive properties. The former method has been developed with great success by Dr. F. W. Aston of Cambridge, incredibly small quantities being sufficient to give definite evidence of a new element. Eka-caesium has probably been found associated with one of the alkali metals—lithium, sodium, potassium, etc.—as its atomic number (corresponding with the weight of the atoms) is 87, which brings it into this group of elements. The discovery is especially important in relation to radioactivity. It seems exceedingly unlikely that potassium and rubidium themselves can be radioactive, yet they have been observed to behave as if they possessed this property. Evidently it is due to their association with eka-caesium, whose discovery should therefore throw new light on the problems of radioactivity. Of the ninety-two elements of which all matter is believed to consist, only one (No. 85) now remains to be discovered.

* * * * *

Thomas Edison was probably the most prolific inventor the world has ever seen. In the space of forty years he took out over nine hundred patents in America alone, and at one period, in 1882, he was patenting inventions at the rate of one every three days. Edison is credited with the assertion that genius is one per cent inspiration and ninety-nine per cent perspiration, and he certainly lived up to this maxim. So many of his inventions have long been household words that it is not necessary to mention them here. The name of Edison will always be associated with the development of telegraphy and the incandescent lamp, but it is not generally realized that he produced the first "talkie" as long ago as 1893. In 1877 he had invented the phonograph in which a needle created vibrations by grooving a cylinder covered with tinfoil. Sixteen years later the inventor's "kinetoscope" was first demonstrated at the Chicago World's Fair. This was a small device in which moving pictures were exhibited. It was a very primitive form of entertainment, for the film was not thrown on a screen but was observed by one person at a time through a small aperture in the machine itself. With characteristic foresight, Edison then set to work to combine the moving picture with the sound recorder. The result of his ingenuity was a machine called the "kinetograph" which successfully combined sound and scene for the first time. It is curious to note that it was not until thirty years later that the "talkies" became a practical proposition.

* * * * *

The "world troubles" of which General Smuts wrote in *Discovery* last month unfortunately came to a crisis just before the British Association meeting. In consequence the centenary celebrations gave place to politics in the newspapers and the public missed some interesting announcements. It was particularly unfortunate that the President's Address did not have wider attention, for behind a discussion of deep philosophical interest there was a warning for the future of civilization. He said that the advance of science has outstripped man's ethical advancement, indeed there is a serious lag which "has already found expression in the greatest tragedy in history." Science is the hope of the future provided that this lag can be made up in time. A pronouncement of public

importance was to be expected from the great statesman who opened the second century of the British Association. It is a pity that this aspect of his address was hardly noticed by the Press.

* * * * *

As it was, some of those who read the address may have questioned its bearing on everyday life. When faced with abstruse aspects of the nature of existence, they are inclined to sympathise with the hero of a well-known limerick, who found it difficult to connect theory and practice :—

> There was a faith healer of Deal
> Who said : " Although pain isn't real,
> When I sit on a pin and it punctures my skin
> I dislike what I fancy I feel."

But apart from the need for further knowledge, which everyone admits, there is another side to the matter which is of great value at the present time. War is not the only danger to civilization ; there is a tendency for distinguished writers, who ought to know better, to disparage traditional standards of all kinds, with results that are only too obvious in Sunday papers and the cinema posters which disgrace our streets. In the important task of raising public taste, all the evidence available is needed in support of the reality of spiritual values. General Smuts has rendered a great service in marshalling the facts so clearly, giving hope in place of pessimism and showing that " science is at last coming into its own as one of the supreme goods of the human race."

* * * * *

We have received from Professor Conway an interesting note relating to the article on Paestum published in our October issue. " It happened to me last summer," he writes, " to be gazing for an hour or two across a quarter of a mile of rough water to the great temples of Paestum, of which a delightful photograph appears in *Discovery*. Had I known then what was going on, I should have been even more disappointed at not being allowed (by the waves) to land from our steamer. But the article by Professor Amedeo Maiuri was all the more welcome reading. The very name carries with it a striking historical record in the mutilation of the Greek *Poseidonia* into the barbarous *Paestum*, by the tribe of Samnite conquerors from the north who spoke Oscan and called themselves Lucanians. We happen to know the dates of their possession of the town fairly precisely ; it was captured from the Greeks about 390 B.C., and was colonized by the Romans in 275 B.C. The solitary monument of the language of the town in this period hitherto has been some coins all labelled *Paistano*. The prospect of having the cemetery of these people uncovered, arouses a hunger which may seem rather ghoulish to the man in the street, but which is very keen in the minds of students of ancient Italy. The hope of securing what may well prove to be a rich bag of tombstones, written in Oscan in the fourth century B.C. and likely to teach us a good deal about the early history of Latin itself, is quite exciting."

* * * * *

Professor Conway goes on to refer to the proposal to excavate the even more interesting site of Corfinium, in the centre of Italy, which he described in *Discovery* last year. " That town was never a Roman colony, and we know that North Oscan was spoken there down to the time of Julius Caesar, so that there we might get a record of several centuries ; but we may learn much even from Paestum where the Samnite invaders probably learnt to write, from the Greeks whom they had conquered, a good long time before that accomplishment had come to be cultivated in the heart of the mountains further north. Professor Maiuri's article shows that the antiquities already recovered have much to teach us of one of the most formative periods of Italy ; and if only the architectural record could be supplemented by some articulate utterances of the men of Paestum in their own language, we might learn things even more interesting of the people of the Samnite highlands who defied the power of Rome for a century, being, in fact, as the linguistic evidence shows, of close kin to the noblest strain of the Romans themselves, *i.e.*, the Patricians."

* * * * *

Aeronautical problems are discussed in this month's issue from two important points of view. High speed flying is the subject of an article by Mr. J. L. Nayler, who predicts that it is merely a matter of time before the speed of sound is attained by man. There are many problems, however, which the high-speed flyer and the aeronautical engineer have yet to overcome. The possibilities of high-speed flying are most fascinating, and Flight-Lieutenant Stainforth's remarkable achievement of 407 miles an hour in a Schneider Trophy plane has gripped the public imagination. As Mr. Nayler reminds us, Britain now holds the record for the fastest speed on land, sea and air. On another page, Mr. Gordon England discusses the future of the gliding movement. British gliders have accomplished many notable achievements and interest in this important branch of aeronautics is growing. As Mr. England points out, gliding is not merely a sport, for the lessons learned are of the utmost importance to pilots and to aeronautical engineers.

Anthropology, Old and New.

By E. N. Fallaize, B.A.

The principles of the "new anthropology," which repudiates any antiquarian interest in origins and survivals, were expounded at the centenary meeting of the British Association. In a new book, however, Sir James Frazer meets the critics who would regard older methods of study as relics of a bygone age.

WHETHER by happy chance or by design, Sir James Frazer had garnered his sheaves* on the eve of the centenary celebration of the British Association. Conventionally such an occasion as the passing of the hundredth year is an opportunity for reminiscence and retrospect. Anthropology, however, and more particularly that branch of it of which Sir James Frazer is the foremost exponent, was not only not represented when the British Association held its first meeting in York a hundred years ago, but as a science the discipline we now call "anthropology" had not come into existence. Although curiosity about our neighbours' habits and beliefs must be coeval with mankind, and, to go no further back than classical Greece, Herodotus must be reckoned among the greatest of ethnographers, yet it was not until after Darwin had published "The Origin of Species" in 1859 that the related enquiries, which we now group together as the Science of Man, began to assume coherence and to elaborate a method.

The range of topics which have been studied under the aegis of anthropology is so vast and its literature has become so voluminous, that it is with a feeling almost of surprise that we recall that Sir James Frazer was a younger contemporary of the founders of the science—Huxley, Tylor, Galton and Avebury, to name the best known only—and realize that in this volume of collected pieces, ranging in date of original publication from 1885 to 1929, his activities in literary form begin only one year later than the whole period during which "Anthropology" has been a separate and independent section of the British Association.

An Early Classic.

In the history of Social Anthropology two names will stand out for all time. They are those of Sir Edward Tylor, "the Father of Anthropology," and Sir James Frazer. When in 1885 Frazer read before the Anthropological Institute the first paper reprinted here "On Certain Burial Customs," he acknowledged his debt to Tylor. This communication, which has long been regarded as a classic, develops the thesis that all over the world, burial customs are to be interpreted predominantly as arising out of a fear of the dead—measures of precaution against the return of the ghost. In the discussion which followed the reading of the paper and is reprinted here, Tylor remarked that "Mr. Frazer's original and ingenious treatment of the evidence must materially advance the study of animistic funeral customs," and concluded by expressing his satisfaction at "the excellent results of Mr. Frazer's study of classical authors, not as ancient texts, but as repositories of facts full of anthropological value."

The Master Hand.

Although the paper already shows the sure touch of a master hand, to a young man entering the arena of discussion in what was then a thorny subject this commendation from a man of Tylor's intellectual eminence must have seemed praise indeed. To us, who with time have gained perspective, it seems to fall short of recognition that a new force had entered the anthropological field. Within a few years Frazer's personality had come to dominate the lines of investigation in the subject which by that time he had made his own, and for long research in the comparative history of custom and religion and in folklore drew its inspiration almost entirely from his method and example.

In the papers which here follow under date of the succeeding years we find Frazer pursuing further the study of classical authors on the lines which Tylor had commended, treating the obscure practices to which Plutarch refers or the dogmas of the Pythagoreans as survivals of early custom and belief to be elucidated by reference to analogous practices and beliefs among primitive peoples. Of these the most considerable on "Vesta and the Vestals" deserves mention, if only on account of a remarkable endorsement of the validity of Frazer's method as an instrument of scientific discovery. It is, perhaps, hardly necessary to remind readers of *Discovery* that one test of the validity of a scientific induction is its ability to predict the line of future discovery. In

**Garnered Sheaves.* By SIR JAMES FRAZER. (Macmillan. 21s.)

comparing the practice in early Rome of entrusting the sacred fire to Vestal Virgins with the customs of the Damaras of South Africa, among whom the care of the sacred fire of the tribe in the chief's hut devolves on the chief's daughters, Frazer suggested the probability that it was the *unmarried* daughters of the chief who were responsible for performing this duty, though this was not recorded in the evidence then accessible to him. Such, however, subsequent research showed to be the fact.

The Theorist.

It is worth while to refer to this example of the soundness of Frazer's judgment. When the time comes for a critical examination and digest of the work done in the field before the great spread of white civilization and the break up of tribal custom which has followed the war in so many areas, it will appear in how many cases Frazer's hypotheses have guided enquiry to facts unsuspected by earlier observers, however accurate. A careful comparison of successive editions of the "Golden Bough" would furnish many instances of the conversion of reasoned hypothesis into recorded fact. Sir James himself offers an example when, referring to the essay on "Taboo," reprinted here from the ninth edition of the "Encyclopaedia Britannica," he says with a characteristic modesty of phrasing that the view therein expressed as to the world-wide occurrence of taboo has now become an anthropological commonplace.

If there is to be any discrimination in awarding merit to the field worker and the "arm chair" anthropologist, as it was once the custom to call the man of theory, partly in jest, part in earnest, this is no place to adjust the quarrel. In his lecture on "The Scope and Method of Mental Anthropology," delivered at Trinity College, Cambridge, in 1921, Frazer defines the functions of the two types of enquiry in a way which accords to each its proper field. From the field worker he demands a careful observation and record of facts, but no more. Here there is no place for theory. "The work of comparison," he says, "is entirely different from the work of observation and should always be kept separate, it is itself of high importance and indeed essential to anthropology. . . . It is the application of the comparative method to the heap which evolves order out of chaos by eliciting the general principles or laws which underlie the mass of particulars." This is the work of the theorist.

Further, the detection of similarities, often in widely separated parts of the world, frequently suggests questions which it is desirable to put to workers in the field, opening up fresh lines of enquiry of which the observer would not have dreamed before. The Mackie Expedition to East Africa, of which some account as it appeared originally in *The Times* is given here, was in fact such a happy combination, and the many invaluable observations made by the late Rev. J. Roscoe on that expedition, as well as his earlier studies on the Baganda, owed an incalculable amount to the wise counsel and suggestion of the theorist, Sir James Frazer himself. It would be vain to attempt an enumeration of other expeditions in various parts of the world of which the same would be true. It would involve almost a complete history of British anthropology in the field during the last thirty years and more. One instance, however, cannot be passed over, that of Central and Northern Australia, in which the researches of the late Sir Baldwin Spencer and F. J. Gillen produced results which have profoundly affected anthropological studies.

But times change and we with them. For nearly fifty years Section H (Anthropology) of the British Association has listened to theories. Some have had their day and vanished; others have died still-born. For over twenty years an Historical School has pressed the case of the study of culture in terms of diffusion; and now the principles of a school of functional anthropology, which expressly repudiates any antiquarian interest in origins or survivals and seeks to interpret custom solely in relation to function in the culture of peoples as they exist to-day, have been expounded from the Presidential Chair at the Centenary Meeting of the Association in London. Despite these innovations, or perhaps because of them, Sir James Frazer meets the critics who would relegate older methods to the dusty upper shelves as relics of a bygone day, by once more attesting the faith that is in him.

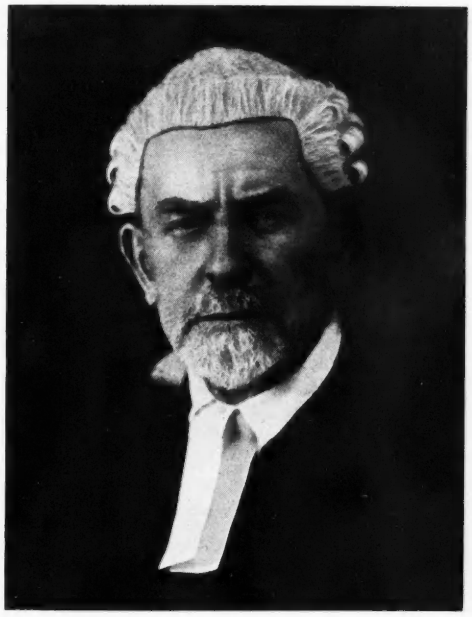
A Convinced Darwinian.

In his lecture to the students of Trinity College, Cambridge, to which we have already referred, he once more expounds the principles which have guided him as a philosopher and student of mankind in his life-long pursuit. As a convinced Darwinian he seeks the evidence for a psychic development in man from primitive to civilized, parallel to the physical development for which the evidence is gradually being pieced together by the physical anthropologist in his research on early types of man.

In the study of the origin and descent of man each new discovery, each new type, such as Peking Man, brings us nearer a conception of what features we might expect to find in the rudimentary form ancestral

to man and his congeners. In like manner the student of culture on developmental lines, recognizing, as does Sir James, that "primitive" is merely a descriptive term, convenient though inaccurate as applied to existing races—Sir James in his address to the Renan Society says he has never seen and never hopes to see a primitive man—yet seeks to elucidate by the study of survivals the rudimentary forms of custom and belief and to trace the line of development therefrom to the culture of modern civilized man.

Understood in this sense social anthropology, or mental anthropology as Sir James Frazer here prefers to call it, ranges over a wide field, in part, perhaps, already covered. For, as he points out, the mind of man for ages has been investigated by a whole series of special studies "which under the various names of psychology, logic, metaphysics and ethics, sometimes summed up under the general title of philosophy, have made great and noble contributions to the science of man." But, he goes on, there is still a field untouched in which anthropology may legitimately function without encroaching on the domain of the older studies, when it turns its attention to the earlier stages of man's development, of which they have hardly taken account. Anthropology, he holds, is rightly to be regarded as a science of origins, "until lately a no-man's land, untrodden by the foot of science." Hence the preoccupation with the customs and beliefs of peoples at lower stages of culture, who, for convenience of nomenclature, are termed savages and "primitive" in a looser sense.



[*Bassano.*

SIR JAMES FRAZER.

For a great number of years both in and out of season anthropologists have strongly urged the need of increased support for their science. It has been pointed out that material of incalculable value to that science is vanishing day by day. Primitive races are dying out, as in the Pacific; or the economic development of lands, until recently remote from white civilization, is bringing about changes which are rapidly modifying or even obliterating traditional custom and belief. To this is added the material argument that for the proper administration of the affairs of native peoples of the Empire it is essential that their social organization and religious rites should be recorded and made the subject of scientific study; while the officials governing these races should have a training in anthropology. In urging the claims of a new orientation in the study of primitive peoples, an orientation which breaks away from the historical and evolutionary point of view, Professor Radcliffe-Brown made out a strong case at the British Association meeting for what he calls "Comparative Sociology." It will appeal to those who are impressed by the urgent need for the scientific study of the races who are suffering rapid change under the social and economic pressure of modern conditions, for example, in Tropical Africa. This is a point that was strongly emphasized by Lord Lugard in a lecture on "Africa in Transition," delivered before a joint meeting of the Anthropological and Geographical Sections of the Association. He said that the new exploration of Africa lay in the investigation of the effect of changing conditions on the African native. It was here that the assistance of the trained anthropologist was needed. But in order to lay broad foundations on which the superstructure of the future might be erected it was necessary to study not the African of the past or even the African of the present, but the African of the future. On the other hand, he did not fail to add that for this an apprehension of both the present and the past was requisite.

And herein we may see in a higher synthesis the reconciliation of the academic and the practical. Perhaps after all we may not have to lay our methods of the study of origins on the top shelf. For the philosophic study of the development of man's mind and his institutions will still afford a key to the understanding of the record gathered under the more strictly scientific methods which the march of circumstances have forced on us as the "new" anthropology.

Travelling as Fast as Sound?

By J. L. Nayler, M.A.

The recent Schneider Trophy contest has again drawn attention to the question of high speeds. A speed of over four hundred miles an hour has already been attained in the air, and in the following review of future possibilities, the author looks forward to the time when man will be able to travel at the velocity of sound.

MAN is becoming so accustomed to the idea of attaining very high speeds in the air, on land and on the sea that a review of the future possibilities and of certain limitations on improvement has considerable interest. Many have queried the physiological strength of the individual to stand up to very high speeds, and this is the direction where there are as yet no signs of a limit to progress at the present time. There are limitations which may retard progress, but these are either due to aerodynamic causes or to the difficulty of obtaining a greater horse-power from an engine with a proportionately small frontal area. We will first deal with the human element.

A few men have run 100 yards in $9\frac{3}{5}$ seconds and so have attained a speed a little greater than 21 miles per hour over this distance. At first sight it might appear that the human body as a whole had some limitation which would prevent its reaching a greater speed than this, and no doubt prehistoric man thought so, although he must have realized that other animals and a few birds with a structure of bones and flesh also similar to his own, moved at speeds about three times as fast. His next stage was to ride a horse and thus to double his speed without any undue discomfort, though his risk of fatal injury were greatly increased.

Now the same fact in general is true to-day and man feels no discomfort, apart from the noise of the engine, when travelling steadily at 400 miles per hour, a speed exceeded during the recent speed trials on the Solent. There is this difference to be noted, however, namely, that the man on the horse has the full force of the wind when the animal gallops, whereas in the racing seaplane he must not put out into the full air stream say a hand or he will have it so violently blown backwards as probably to break his wrist. The pressure on his hand would amount to about 70 lbs. at 400 m.p.h. Seated in his cockpit he will, however, experience a pressure either less or greater than that of the atmosphere, according to the arrangements of the design to let in or exclude air, which can be varied from the head-on pressure of three pounds to the square inch to a negative pressure exceeding this figure. Incidentally, apart from any heat given out by the engine he will experience a temperature rise due to his speedy passage through the air of about 15°F.

Looking ahead to still higher speeds there does not appear to be any factor among those already mentioned which is likely to have an adverse effect on the human frame until somewhere near the speed of sound is reached at 740 m.p.h. (1,080 feet per second); then owing to the formation of pressure waves and the rapidly increasing resistance it is difficult to predict what will happen. Already the pressure effect of the passage of the wings through the air is shown up on days of high humidity by a stream of mist behind each wing of a Schneider racing seaplane. A speed as high as 740 m.p.h. maintained continuously for an appreciable time seems unlikely to be reached by the present generation for a number of other reasons.

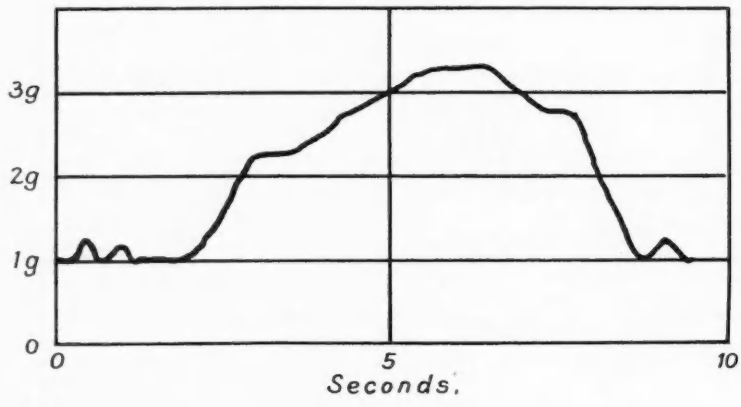


FIG. 1.

The diagram shows the acceleration experienced in a fast modern aeroplane during a tight turn. The pilot is trained not to exceed certain stresses so as not to break the structure.

The question might reasonably be asked whether the speed of sound might be reached for a short time, say one minute, as many small and a few large projectiles start their flight at speeds greater than that of sound. The human frame is always subject at rest to gravity forces or in aeronautical terminology to an "acceleration of 1g." From experience in aeroplanes it seems that for about two seconds 8g can be experienced without injury, but that 10g or 11g will result in permanent injury at least. There are on record single exceptional cases which are difficult to understand when this acceleration has been exceeded, such as the man who fell in September, 1931, from a height of 60 feet on to a heap of ballast on the site of the Hotel Cecil and who was later reported by the hospital authorities to be uninjured; he walked home afterwards. To attain or exceed the speed of sound by any known method except a rocket will need a high acceleration for many seconds, so that experiments in this direction are not likely to produce good results. Moreover, even with rockets the acceleration will be high and the difficulty of landing safely will be great even with an aeroplane structure; in fact, Herr Opel's experiments on rocket cars and aeroplanes have not been so successful as to warrant a vigorous prosecution of this line of research.

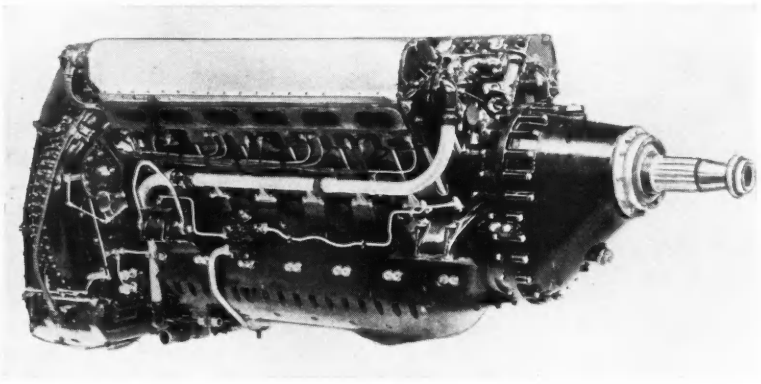


FIG. 2.

The "R" engine which is fitted to the S.6.B seaplane. It is by far the most efficient aircraft engine in the world and weighs only 0.75 lbs. per horse-power.

In another way high accelerations are sure to be incurred as it is necessary to return at some time to a starting point. Fig. 1 shows the amount of accelerations experienced in a fast modern aeroplane during a tight turn. It is a measure of the pilot's feelings rather than the speed of the aircraft, as he is trained not to exceed certain stresses so as not to break the structure. This shows a maximum of about 3g. Considering the simple turn it is immediately obvious that turning on the same circle at 400 m.p.h. will put on stresses nine times as high as 133.3 m.p.h., a fast cruising speed for a civil aeroplane. The alternative is to turn in a wider circle, which in view of the speed reached means a very wide sweep. Therefore very high speed aircraft are going to need large manœuvre areas, apart from any considerations of the distances required to take off and land even under ideal conditions.

In the high speed car problem the runs have been along straight stretches, the car losing most of its speed before turning for a run in the opposite direction; as in only a few parts of the world are there long straight flat stretches of ground, very high speed motors must remain a pure sport without any commercial development other than a stringent test of materials, manufacture and design. The aircraft, once it is in the air, does not suffer from this restriction, but it is dependent on the care needed not to overstrain the human body. Although pilots can lose their sense of sight for perhaps as long as a second under $4\frac{1}{2}$g to 5g when rounding a pylon on the Schneider Trophy course and still retain their muscular sense, this is possible only for the highly trained person. The high speed aircraft for the many will therefore have to be flown with care and have large areas for manœuvre. Apart from this need for care in manœuvre there is at present no limitation imposed on high speeds by the mere human factor.

Until races are inaugurated on pilot-less aircraft controlled by wireless or some other means, the first essential is to carry a pilot. Anyone who has seen the small space allowed for the driver of the racing car and the smaller space for the racing pilot will realize that very close attention has been paid to presenting the minimum resistance to the air. If we take the frontal area of a man sitting down as four square feet then his resistance at 400 m.p.h. is of the order of 2,000 lbs.—nearly one ton. By comparison, the resistance of the Supermarine S.5 seaplane, if it had flown at 400 m.p.h., would have

been approximately the same figure. The body has a greater cross-sectional area and is approximately five square feet in the maximum section, a dimension partly dependent on the size of the engine. Now the resistance of a good streamline body, such as an airship without fins, is only about five per cent of a disc of the same area at the same speed. The man's frontal area is therefore streamlined and its resistance is reduced to about 14 per cent of its original value. This is not the only consideration as there must be controls, rudder and elevator to direct the craft, the rudder adding some 40 per cent to the resistance of the body and engine alone. In spite of this, its resistance is only one-fifth of the same cross-sectional area when not streamlined and it has been given directional stability when it is propelled through the air.

The resistance of the best streamlined bodies is entirely due to the friction of the air flowing over the surface and is called skin friction. The body of the racing seaplane of to-day at its minimum resistance very closely approaches the figure for the skin friction calculated for an area equal to the total surface. This is not the case for the wings, which drive the air downwards so as to create lift and thus add an induced resistance which is about half the total. Considered from this point of view, it might appear that as a motor-car has its weight borne by the earth, its resistance should be much less, provided it is so designed that all areas are properly streamlined. The reason is that the frontal area of a racing car is larger than that of the S.6.B and both contain the essential human being. Moreover, the car has wheels which have a high resistance. In addition there is the tractive resistance of the wheels on the ground which is so great that the tyres have to be renewed every few miles. Perhaps on this last account only, it is probable that wheeled vehicles are never likely to attain such high maximum speeds as craft which are wholly air-borne.

Having reduced the resistance of the body carrying the man and his power unit to a minimum, it is essential to have as much horse-power as possible; as it has to be air-borne to get the maximum speeds, the weight per horse-power must be as low as possible, since every extra pound carried will mean so much extra induced drag and consequently a still greater increase of horse-power to overcome this drag (about 10 per cent). Our illustration (Fig. 2) shows the "R" engine fitted to the S.6.B. It is by far the most efficient aircraft engine in the world, and the recent British triumphs are in a great part due to the excellence of its design. This engine weighs only 0.75 lbs. per horse-power and a few of its main characteristics are worth enumeration. In the first instance its frontal area does not greatly exceed that of a sitting man (Fig. 4), being 40 inches high by 30 inches broad, dimensions which permit of a streamline body to enclose the pilot suitably behind it and a view forward between the two banks of cylinders. It gains its 2,300 brake horse-power at a weight of 1,630 lbs., representing a power increase over the 1929 engine of 21 per cent for a weight increase of 6½ per cent. This result was attained by raising the engine speed for the Schneider Trophy race to 3,200 r.p.m., by raising the supercharger gear ratio and by increasing the size of the air intake. From a calculation based on the improvement attained in the speed record it would seem that in the "sprint" engine at least another 300 horse-power must have been developed for approximately the same total weight by running the engine at a higher r.p.m.—a remarkable achievement.

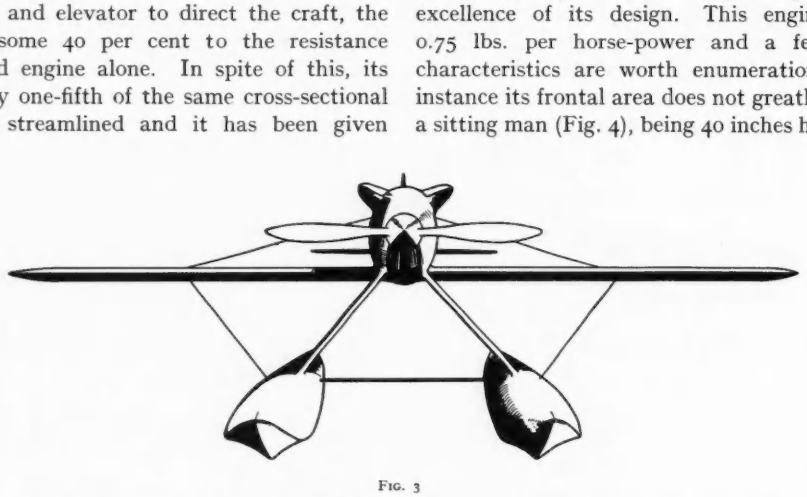


FIG. 3

A head-on view of the Vickers Supermarine Rolls-Royce S.6.B seaplane showing the small frontal area presented to forward motion. The man's frontal area is streamlined and its resistance is therefore reduced.

The high power developed by the engine means a great expenditure of heat, and this has to be dissipated rapidly or else the engine would overheat and fail to function. A rough idea of the rate of fuel consumed can be gauged when it is realized that the petrol is burnt faster than it can be poured out of a two-gallon can. In fact, whereas the outer surfaces of the aircraft were almost sufficient in the seaplane which won the Schneider Trophy Race in 1929, this is no longer the case and louvres have had to be fitted to direct air

between the upper and lower surfaces of the wings so as to gain a more rapid cooling of the wing radiators. The whole aircraft has almost become one huge radiator for dissipating the 40,000 British Thermal Units per minute and thus cooling the water and oil used in the engine. This has tended to limit the maximum speed in the 1931 race. For the speed records flown a fortnight later some of these louvres were removed, as the speed was maintained for only short bursts on the approach to and over the three kilometre course, the engine having time to cool between each run.

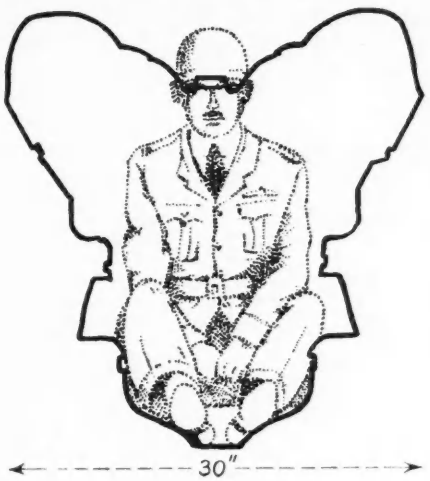


FIG. 4.
This scale drawing of a pilot seated in a machine shows the superimposed frontal area of the engine in the seaplane S.6.B.

At present there seems to be no limit in sight to the maximum speed that can be reached. The curve given in Fig. 5 shows how the speeds attained in the Schneider Race have each year increased steadily, and the apparent slackening off in 1931 is due to the more severe conditions of this year. The speed record has, however, jumped forward in the two years by at least the same amount as previously. What then are the limitations? We see that the pilot is streamlined already as much as possible and that there is some difficulty in getting rid of the heat generated by the engine, which is already small in cross-section for its horse-power. On the other hand, means have been devised during the past two years to overcome this difficulty of heat dissipation. If the engine designer can continue to construct engines which will run still faster without a proportional increase in weight, so that the weight per horse-power is still further reduced, then the aerodynamist will devise means, perhaps using wings whose area can be altered at will so that the engine can be taken into the air, be pulled at still higher speeds by the airscrew which has by no means reached its limits of design, cooled by devices for making more efficient the available surfaces of the craft, and no doubt if the power available be large enough design a much larger body into which the floats with their load of fuel can be absorbed after the craft has left the water. Already there are aeroplanes flying in which arrangements have been made to retract the undercarriage wheels into the body, and floats may well be expected to follow. The saving in resistance, if floats and struts were omitted, would amount to as much as one-half the total for the whole aircraft. Given the necessary incentive and the funds, there appears to be no reason why speeds should not continuously increase until they approach the velocity of sound at 740 miles per hour, when owing to the rapid increase of resistance of all objects near this speed it is impossible to predict the precise behaviour.

Because of our interest in sport, and because a saving of time means a saving of money, this country has taken a great interest in speed records. This is strikingly illustrated by the fact that we hold the world's speed record for aeroplanes, motor-cars, motor-cycles, and motor-boats. The figures are: Aeroplanes (Stainforth) 407.5 m.p.h.; motor-cars (Malcolm Campbell) 246.09 m.p.h.; motor-cycles (Wright) 150.7 m.p.h.; and motor-boats (Kaye Don), 110 m.p.h.

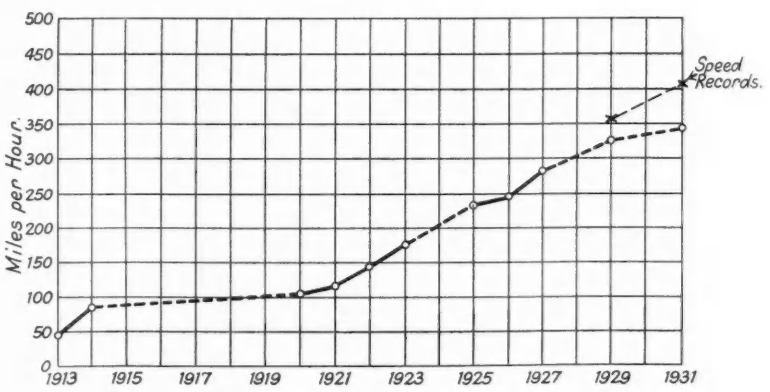


FIG. 5.
The curve shows how the speeds attained in the Schneider race have each year increased steadily, and the apparent slackening off in 1931 is due to the more severe conditions of this year.

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Eighty Thousand Birds' Eggs for the Nation.

By Cyril Hopwood.

Mr. Stuart Baker has just presented to the nation his unique collection of eggs from the Indian Empire. While in the Forest Service at Burma the author was himself able to contribute many rare specimens to the collection, and is therefore qualified to write the first full account of Mr. Baker's work to be published.

THE vast collection housed in the Natural History Museum at South Kensington consists primarily of single units, laboriously gathered over a long period of years, and it is only at rare intervals that it has been enriched in one act by the life work of a specialist, as in the case of the Adams' collection of butterflies of the whole world or the Gould collection of humming birds. Now as recently announced in the Press, Mr. E. C. Stuart Baker, honorary secretary of the British Ornithologists' Union, has just completed arrangements with the Trustees of the Museum to hand over to them his unrivalled collection of eggs of the birds of the Indian Empire. Although Mr. Baker has himself described some of the rarities in specialized journals, this is the first occasion upon which he has permitted a review of his work to be published, and it is by his courtesy that I am permitted to give an account of his magnificent gift.

More than fifty years ago, Mr. Baker began to form the collection which was destined to become not only the largest but both intrinsically and scientifically the most valuable of its kind that has ever been gathered together. He was at that time a junior member of the Imperial Police, and the collecting of birds' eggs was undertaken originally as a hobby to while away the tedium of the long days spent in camp in the frontier hills of Assam. But his hobby soon took the form of serious scientific work, for Mr. Baker conceived the idea of attempting to obtain specimens and series of the eggs of every bird inhabiting or visiting India, Burma, and Ceylon. His object was not merely to amass a vast number of egg shells, but holding the view that oology is a very important part of ornithology, he set out to prove that this could be a scientific pursuit and could provide a valuable clue to classification.

Thus in collecting a series of the eggs of any bird the object was to obtain the common forms of each bird's egg and the extremes of variation, thereby illustrating the characteristic points of natural orders, families, genera and species, the connecting links between them, and the reasons for aberration. The best example of this is provided by what may well be described as the gem of the collection, namely, the marvellous series of eggs of the eastern variety of the common cuckoo, and it is fitting that this variety should have been named by naturalists after Mr. Baker himself.

This bird, which differs from our own summer visitor only in minute colour details, is identical in its habit of laying its eggs in the nests of various small birds. The collection under review contains some two thousand eggs of this variety of cuckoo, and besides exhibiting all the well known colour varieties of the western form, includes many specimens and whole series of shades rare or unknown in Europe. For example, the blue variety, as to the very existence of which there was till recently great doubt, is well represented, and only this season Mr. Baker obtained from one of his correspondents a beautiful series, obviously the product of one bird, of an almost salmon pink. These eggs came from the nests of the white-tailed blue robin, and exactly match the eggs of the fosterer. Each egg of the cuckoo is accompanied

THE SPIDER HUNTER.

The eggs of several species of this bird are included in the collection. The illustration is reproduced from a painting by Mr. Stuart Baker.

by the eggs of the fosterer, and these number upwards of a hundred different species of small birds, thus indicating the immense range of the cuckoo's parasitism. But in addition to the common cuckoo, there are found in India twenty-five other forms of parasitic cuckoo, all of which have similar habits; the eggs of every species are represented and duly authenticated in the collection. The history of how this was achieved would fill a small volume, and bearing in mind the habits of the birds, the infinite labour and accurate observation involved can be better imagined than described.

A NEST IN A LEAF.

The nest of Franklin's wren warbler is placed in a leaf which is sewn up by the bird. The stitches are clearly visible in the photograph.

I am open to correction, but it is probably not very far wide of the mark to estimate the birds of the world at about twelve thousand. Of these, no less than about two thousand three hundred species and sub-species inhabit or visit the Indian Empire. From this it will be realized that Mr. Baker set himself a formidable task. How far he has succeeded in his ambition is evidenced by the fact that the collection contains examples of the eggs of about two thousand different birds, and aggregates about eighty thousand specimens.

It was naturally impossible for any individual to collect this vast number himself; in fact many of the winter migrants breed in localities thousands of miles distant from the Indian peninsular. During his fifty years of work Mr. Baker has had, and still has, correspondents in every part of the world. Through their agency the collection includes the eggs of rare thrushes and warblers from Siberia, wading birds from Alaska, the Goliath heron from East Africa, rare geese from Spitzbergen, and petrels from the Falkland Islands.

Mr. Baker has also been in close touch with every field worker in India itself, and has acquired the whole or part of their collections whenever from one cause or another these became available. Thus there are incorporated in his collection those obtained from the Himalayas by Osmaston, Dodsworth, and A. E. Jones; Colonel Ward's collection from Kashmir and Ladak; Whymper's from high elevations in the Gharwal Hills; those of General Beetham, Field, and Coltart from the plains of India; Tunnard's from Ceylon; and the collections formed by Cook, Mackenzie and the present writer from the hills and plains of Burma.

The majority of the eggs of our English birds are recognizable at sight to the expert eye. This is far from being the case with those of the birds of India. To take one example, there are some sixty species of bulbuls, most of which lay very similar eggs; their correct identification is further complicated by the fact that there is a great deal of variation in colour and marking in the eggs of a single species. It is only by the closest and most accurate observation of the nesting birds that the species can be duly authenticated; and the value of Mr. Baker's gift is greatly enhanced by the fact that every clutch of eggs is accompanied by a signed data ticket, the authenticity of the eggs being vouched for by Mr. Baker himself, or by some other ornithologist of unquestioned repute.

In addition to this, the whole collection has been minutely and accurately catalogued, and every egg has been carefully measured and the dimensions faithfully recorded! They range in size from the huge eggs of the cinereous vulture, which are just short of four inches in length, to the tiny white spheres of the flower-peckers which barely exceed half an inch. A well displayed collection of the eggs, even of our common British birds, is a very beautiful thing. It may therefore well be imagined that many exquisite examples will be found in such a collection as this, and the expectation will not be disappointed.

For sheer beauty, I am inclined to give pride of place to the lovely little eggs of the wren warblers, some of which sew up leaves like a tailor-bird to construct their nests, others weaving a little purse of grass which is attached to reeds or grass stems. The yellow-bellied and ashy wren warblers lay an egg of a glossy brick red, while the Indian wren warbler and its sub-species lay eggs of a brilliant sky blue, spotted and streaked with red and blackish purple. This is the normal type, but from Gonda, in Oudh, comes a variety which is creamy-white with blood-red spots and blotches; from South Burma the eggs are dull pinkish with reddish blotches and scrawls,

whilst from Siam comes a beautiful pink egg with large blotches of blood-red, purplish-red or black.

There are several hundreds of these eggs in the collection, exhibiting all the variations alluded to above, and they are almost matched in beauty by the wonderful series of eggs of the rose finches, birds allied to and somewhat resembling our own linnets. They breed at high elevations in the Himalayas, Kashmir, and Ladak and the extreme north of Burma, and lay an exquisitely coloured blue egg, delicately marked with black.

There is an extremely fine series of eggs of the lammergeyer, or bearded vulture, from the Himalayas, many of these being extraordinarily handsome; and there is a wealth of eggs of the waders, such as plovers, sandpipers, and their allies. Among them is a red (erythronistic) variety of the lapwing, and also authentic specimens of that great rarity, the knot. Into this category also comes the egg of the eastern sand plover, a bird which breeds among the rocks at an elevation of 14,000 feet, and is considered by Mr. Baker to be one of the rarest, if not the rarest, in the whole collection.

HOME OF THE WEAVER BIRD.

The striated weaver builds an ingenious nest. The entrance tubes, sometimes a yard in length, afford protection against marauders.

Other unique items which have never previously been available for study by ornithologists are the eggs of the white-winged black jay, taken by the writer in the dense evergreen jungles of South Tenasserim, the black-browed Suthora, the Shillong laughing thrush, several species of babbler and bulbul, the Beautiful nuthatch, Baker's wren, some new flycatcher-warblers and flycatchers, the white-browed bush robin, Gurney's pitta, the ruddy barbet, Godwin Austen's hornbill, the bay owl, Horsfield's goshawk, the black-legged falconet (which breeds in holes), the wood snipe, the Thibetan brown-headed gull, and the white-winged wood duck. This by no means exhausts the list of supreme rarities, but is a selection made by Mr. Baker himself in response to a request for his own view as to the cream of the collection. In view of the inaccessible position of many of the nests—for example, the cliff breeding vultures and falcons, and the crested swift, which has a penchant for attaching its tiny nest to a rotten branch on a dead tree—it is not without considerable risk of life and limb that this collection has been formed, and there is the ever present danger of wild beasts, venomous snakes, and such smaller but unpleasant creatures as scorpions and hornets. A book of adventure could be written on the experiences of Mr. Baker and his assistants, and would make exciting reading. On one occasion Mr. Baker came face to face with a full-grown tigress while peering into a bush where he thought he had located a nest; and one of his native collectors was killed by a tiger while searching for floricans' eggs in heavy grass jungle in the valley of the Brahmapootra. I myself had the unpleasant experience of being stung by a scorpion which had taken up its abode in the nest of a Scimitar babbler, and one of Mackenzie's men fell and was seriously injured when taking an eagle's nest.

But the difficulties and dangers inseparable from the collecting of birds eggs in the wilder portions of the world, and the surmounting of them, add a zest to this engrossing occupation. Only those who have indulged in it can fully appreciate the peculiar satisfaction that is derived from the finding of a nest that may have baffled one year after year, and in the wilds one is entirely absolved from the opprobrium rightly attached to the robbing of nests in England. For the number of eggs that can be taken even by the most expert and zealous of collectors is infinitesimal in comparison with the number destroyed by natural enemies such as snakes, lizards, ants, rats, and marauding birds of the crow tribe.

To give an instance, the pretty little babbler known as Tickell's staphidia, rather a rare bird, is found in considerable numbers on Nwalabo mountain in South Tenasserim. It makes its nest, which is rather like that of an English robin, in shallow holes in banks, and it is an easy matter to find a dozen or so of these

in a morning's ramble. But it is a very different affair to get a clutch of eggs, as these are devoured almost as soon as they are laid by the tree shrews, little squirrel-like creatures which swarm on the mountain. Yet in spite of this destruction of their eggs there is no diminution in the number of the birds. The fact is that when a nest is robbed the birds lay again and again until their efforts to rear a brood prove successful.

The immense labour involved in forming and cataloguing this superb collection would have been enough for most men, but Mr. Baker is a glutton for work, and during the last few years has found time to re-write the volumes of the fauna of British India dealing with birds. The first of these was published in 1922, and the eighth and final volume in 1930; they not only contain all the original woodcuts published in Oates' four volumes, but the illustrations have been largely added to by a number of beautiful coloured plates of birds and their nests, the work of Mr. Baker himself, who adds painting to his other talents. The value of the work is also greatly increased by the notes, now incorporated for the first time, on the nests and eggs of very many birds whose breeding habits were previously unknown.

In writing these volumes Mr. Baker has made use of the trinomial system—of which he is one of the pioneers—for the scientific names of the birds described, for he realized more than thirty years ago the necessity for this. For those unacquainted with scientific nomenclature the following simple example may be cited. The common cuckoo, referred to above, is known to naturalists as *Cuculus canorus*. Under the trinomial system, the western form is named *Cuculus canorus canorus*, thereby indicating that it is the typical form, while the eastern variety is called *Cuculus canorus bakeri*, the third word indicating a variety or sub-species or geographical race. By this means it has been possible to relegate to their true positions many birds which had hitherto improperly held specific rank, and to show their relationship to one another in a simple and concise manner. Moreover, in his descriptions of races and sub-species, Mr. Baker has adopted the plan of describing the points wherein these differ from the typical, instead of repeating the description in full, an arrangement which greatly simplifies the work of students.

FLOATING NEST OF THE JAÇANA.

As the photograph shows, the eggs of the bronze-winged jaçana are laid on a floating network of weeds. The difficulties of the collector can readily be imagined.

EGGS AND FLEDGLING OF THE INDIAN PIPIT.

About two thousand three hundred species and sub-species inhabit or visit the Indian Empire. Mr. Baker's collection contains eggs of about two thousand birds.

It is hoped that before long a small gallery in the Natural History Museum may be devoted exclusively to Mr. Baker's gift, and as soon as this can be arranged, it will be handed over and will be available for study. It is satisfactory to know that Mr. Baker's interest does not cease with the handing over of the collection, as in spite of advancing years, he is still an indefatigable worker both in the Museum and in the field, and during the past summer he made an expedition to Lappland in a successful search for the eggs of waders.

He is still in close touch with a large number of field workers, through whose efforts he hopes to fill in the few remaining blanks and to strengthen those portions of the collection that are weakly represented. At the moment he is hot upon the track of some eggs of a rare blue chat, the discovery of which has just been reported from the remote Chin Hills of Upper Burma. By his very generous gift to the National Collection, Mr. Baker has placed ornithologists, especially those interested in oology, under a great obligation.

Oil Engines for Railway Trains.

By C. M. Beckett, B.A.

The future of the crude oil railway engine is here discussed by an engineer, who predicts that the oil-electric system will replace steam traction and will reign in its place until wireless transmission of power arrives.

CRUDE-OIL rail traction is the successor to steam rail traction, just as crude-oil road traction is replacing the last and most revolutionary of the chain of road engines—the petrol engine. That the hundred-year-old successor to the horse-drawn colliery train should have survived while one form of road power gave way to another is due to the undisputed fact that the steam locomotive has almost from its inception performed the duties required of it, that is, to draw a passenger train at the fastest speed at which a train can safely run and to draw a goods train of the heaviest weight that the truck draw-gear will bear; the manner in which it performed these duties was not perfect in terms of expenditure, cleanliness and silence, but the vastness of the capital invested, and the fact that each railway was planned and constructed in all its details to suit the steam locomotive, naturally prevented any change unless special considerations indicated a financial benefit with a wide margin of safety.

These special considerations have, however, grown in importance during the past twenty years, and at the same time an improved form of tractor has been evolved which for equal duties costs no more than the steam locomotive, which calls for little or no capital to be scrapped, and of which the financial benefits can be definitely reckoned without dependence on the increase or maintenance of present traffic. Why oil-electric traction will replace steam traction and reign in its place for perhaps as long as steam traction has ruled, until perhaps wireless transmission of power has arrived, can best be explained by reference to these considerations.

Suburban Traffic.

How far suburban development has caused rapid transit and how far rapid transit has facilitated the encroachment of town into country need not be dealt with here, but suburban railway traffic must be studied, as the greatest of the special considerations calling for a substitute for the steam locomotive. Powerful acceleration and braking, not speeds of sixty to eighty miles an hour, are required to give accurate timings over a fifteen miles run with stations spaced at an average distance of less than a mile. Powerful acceleration—the attaining of twenty miles an hour in as many seconds—of a 500-ton business train needs 60,000 lbs. tractive effort at the driving wheels, while 60,000 lbs. needs 120 tons above the wheels to prevent skidding. But 120 tons—above the driving wheels—is the weight of some of the most powerful locomotives in the world, besides being an uneconomic dead weight to carry.

Transmitting Steam to Bogies.

The wheels of the passenger stock must obviously be made to drive the train (just as the twice as rapid braking cannot be obtained without equipping every wheel in the train with automatic brake blocks), but how is steam to be transmitted to the bogies of a suburban train? This, to the best of the writer's knowledge, has never even been attempted, and electric motors, suspended on the bogie axles, have been for the past fifty years the only means of affording rapid suburban transit—where density of traffic warrants the cost of transmitting electricity to the trains.

A further special consideration is the pouring of rush-hour traffic in and out of constricted city stations, which calls not only for trains capable of being driven from either end—not impossible on steam trains with the aid of electricity or compressed air—but also for power distributed along the length of the train rather than the concentrated power of a large locomotive, which can pull but cannot safely push a train at speed. This distribution of power also reduces the stresses in the carriages and their draw-gear, thus lightening the train and reducing the cost of its upkeep.

Although the smoke abatement societies have performed valuable services in the case of stationary plant, they do not yet appear to have tackled mobile smoke-producers. This may be because they have recognized the immense difficulties which the railways have to face in the provision of clean and quiet suburban traction where the frequency of trains has not financially justified the equipping of the track for electric working, the reconstruction of its bridges

and civil works, the close fencing of its land, and the surrender to a second party (the generating company) control of its one raw material—power.

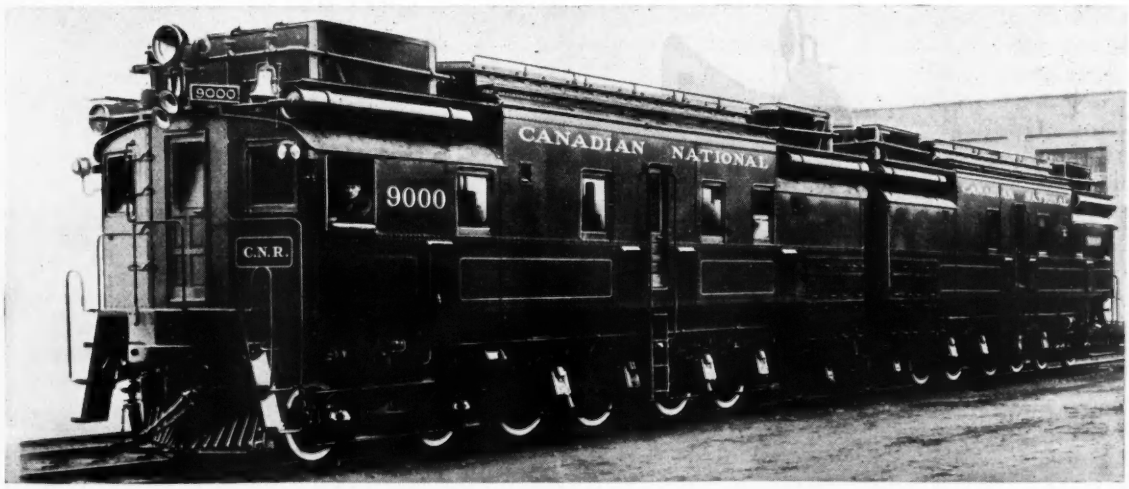
That I have hardly as yet broached the subject of oil-electrification is intentional. It is so far clear that the only known means of supplying power to the bogie wheels of a suburban train is electricity, that electricity can be distributed, controlled from afar, and is smokeless and almost silent ; but if a mountain will not come to Mahomed—the power station must be taken to the train. Of the three known forms of power station—hydro-electric, steam turbine and oil engine—the first appears rather out of the question, the second is bulky and is not automatic in action, while the third is certainly compact, reasonably light, and completely automatic in operation.

The carrying of oil-engine generating sets in a portion of two coaches of the train (where the train is divided in two halves for the light mid-day shopping traffic) or in a special vehicle (where only one power station is required) is *un fait accompli*—in some countries it is the recognized form of frequent station traffic, in this country a form of transport already tried out on a small scale, and within the next few months to be demonstrated in greater numbers.

There is no necessity here to consider the minor economics and amenities of the oil-burning internal combustion engine—cleanliness, long life of wearing parts and longer life of the main portions—high efficiency far more than counterbalancing the higher cost of oil than coal, except one, and that is wages. The power set is—even in stationary plants where the same need does not arise—entirely automatic, feeding itself with fuel without stoking, requiring no watching of gauges, and provided with simple devices for protection in the event of unforeseen occurrences. Such little attention as is required—occasionally shutting down the plant, for instance, to save fuel—is given at a distance by the driver in his cab. The wages of train crew *per train* are thus halved, but without adding to railway unemployment, for it is well known that the public's response to a clean and rapid suburban train service is a demand for more trains—not to mention the important fact that more trains are possible to and from the crowded terminals by virtue of controlling the train from each end.

Quite different considerations have called for a successor to the steam locomotive on branch lines, but before the advent of the internal combustion engine no successor was forthcoming. Here the conditions call for economy in action rather than for a new application of power to the wheels ; for a small unit that will work by itself without waste of fuel, but can on occasions be doubled ; for a self-fired engine that enables twice the number of trains to be run for the same engine crew wages ; and for an engine that is instantly available for relatively short runs without consuming fuel during its resting periods.

The light steam railcar is only a logical solution to the cutting down of locomotive dead weight by putting the steam engine on the passenger coach ; but it and the push-and-pull tank locomotive, with control from each end of the car or of the short train, fulfil none of the conditions demanded. The oil-electric railcar can run by itself or with a normal complement of trailers, and during peak traffic it can



FREIGHT AND PASSENGER LOCOMOTIVE.
This 2,660 B.H.P. locomotive may be used either for freight or passenger service by changing the motor gear ratio.

be coupled to a similar unit, only one driver being required on the train ; and lastly the railcar is always ready for service, ready for stabling, and only asks for oil in proportion to the miles it runs instead of needing coal and attention during the whole of the working day.

Short Runs.

The variety of duties under the heading of shunting make generalization impossible, except under one heading—fuel and attention. The amount of horse-power hours in proportion to the hours of availability must necessarily be small in any service that involves short runs, sometimes light and sometimes heavy loads, and probably intermittent work. The no-load losses of the oil-engined locomotive are nil, attention is not required during the longer rests, and the light-load fuel consumption is roughly proportional to that at full load. When this is compared with the steam locomotive, which consumes coal and requires attention continuously when in service, which needs to be taken out of service for " hostlering " at least once during the working day, it will be seen that not only is the yard's fuel bill halved but that one oil locomotive with two driver's shifts will replace two steam locomotives.

It will be found that in all but small " contractor's " locomotives, the transmission of power between oil engine and wheels is electrical. The reason for this is entirely different from that existing in the case of suburban trains. In the latter it was seen that electric motors were the only known method of making use of the " adhesion " of the wheels of the passenger coaches. Here, however, the oil engine is on the vehicle possessing the driving wheels, and can, if suitable clutches and gears are available, be directly coupled to the road wheels.

A clutch is a means of transmitting a torque from a fast rotating engine to a slowly rotating gear-shaft, and proportional to the difference in speed is the energy to be wasted in heat while the vehicle accelerates. A motor-car, bus or lorry certainly employs this method of acceleration, but these rubber-tyred vehicles, suitable for road gradients of 1 : 6 necessarily have engines powered in the ratio of 10-20 B.H.P. per ton, and movement from rest to the point of fully engaging the clutch is a matter of one to five seconds. Rail vehicles, however, hauling their loads on comparatively frictionless track, where gradients do not normally exceed 1 : 30, are powered from $\frac{1}{4}$-5 B.H.P. per ton, and in the case of shunting it is definitely the lower figure of $\frac{1}{4}$-$\frac{1}{2}$ B.H.P. per ton which is met. Movement from rest to the lowest engine speed on the first gear is therefore a matter of minutes rather than seconds, and while not impossible to design, a satisfactory clutch is in maintenance and first cost an expense quite out of proportion to the lorry clutch. Add to this the fact that shunting work is a succession of starts and stops, that smooth, gradual engagement is necessary to prevent stalling of the engine, that although normal working speeds are less than those of lorries, yet fairly high maximum speeds are required for occasional use with light loads, and it will be seen that even with engines of under 80 B.H.P., the lorry type of drive is not suitable for shunting locomotives. On the other hand, electrical motor drive, where the source of power is in the hands of the driver, is smooth, and is simple and physically easy to control ; is economical because no energy is wasted as in the clutch ; and compensates for its power efficiency by the utilization of full engine horse-power at all train speeds (with gear drive the engine is sometimes running at full speed and power, sometimes at slow speed and half power).

The oil-electric locomotive is therefore supplanting the steam locomotive entirely for shunting work on its merits, no special circumstances existing in this class of work which definitely called for a means of haulage other than steam. In fact, until the advent of the oil-electric locomotive, no alternative was readily available, third-rail or overhead electrification being almost impracticable in a shunting yard, and electric battery locomotives being limited in action and often expensive in first cost (including charging plant), fuel and maintenance. Mention must be made of the oil-electric battery locomotive of which one railway in the United States has recently bought over forty.

Shunting Operations.

Here a relatively small engine can supply the energy for heavy shunting operations, the battery assisting during the peak loads which are inherent in shunting work. It is a question whether battery replacements will or will not prove more expensive in the long run than the extra cost of the heavier engine to perform the same duty, while the loss of efficiency due to charging the battery and discharging it at heavy currents probably tips the scales in favour of the simple oil-electric locomotive. Another few years must pass, and one railway must possess both types of tractor, before true operating costs are available. Meanwhile the oil-electric shunting locomotives are being purchased by railways and factories as their present steam locomotives become worn out.

A special consideration which caused the electri-

fication of several railways in coal or ore mining districts is the possibility of " regenerative " braking, whereby the energy produced in holding a heavy freight train on steep grades is given to the power line instead of being wasted in heat at the brake shoes. In certain cases the gain is definite, while in others there is no certainty of a demand elsewhere for the energy recuperated and the gain is chiefly confined to the saving in wear of brake shoes and wheel tyres. It is too much to expect oil engines to reverse their normal duty and for the fuel pumps to change their direction, while to store the energy in other forms such as in an electric battery would prove cumbersome, and this special consideration is unlikely to assist the oil-electric locomotive in replacing the steam locomotive. (It may be mentioned that " rheostatic " braking, whereby the energy is taken up by the electric motors and dissipated in the form of heat in resistances, is as feasible in the oil-electric as in the electric locomotive where the gradients encountered and the savings in brake shoes merit the extra complication of control equipment.)

High Speed Requirements.

The steam locomotive fulfils admirably the duties required by high speed working, that is, low tractive efforts and little weight required for adhesion ; by work occupying only six to eight hours a day, where low initial cost compensates for other deficiencies ; and by considerations of safety which prevent any attempt to dispense with a second man on the locomotive footplate. The merits of the oil-electric locomotive, suitably designed for fast speeds with the weight of the motors removed from the axles and driving the wheels through flexible gearing, must still be considered in every individual case, and they will more frequently than not be found able to effect savings.

No reasons have been given for the adoption of electric transmission in the case of freight or passenger locomotives. It is merely a form of transmission, easy to control, of long life, smooth in its effect both on road wheels and on engine, reasonably efficient, completely variable over a very wide range, rather heavy (but weight is no defect in a freight locomotive), and not always more expensive than other forms when several hundreds of horse-power are to be transmitted.

As is to be expected, the first oil tractors were put into service where special considerations showed beyond doubt that given a reliable engine, working costs would be reduced or train services improved. Where no special considerations existed, railways on the whole were inclined to " wait and see," but certain managers, with the courage of their convictions and the assent of their directors, applied oil-electric traction on more than an experimental scale, either for their suburban traffic, for their branch lines, for their shunting yards, and in lesser degree, for all classes of haulage discussed above.

Recent Research on Glass.

DEVELOPMENTS in modern glass making are strikingly illustrated at an exhibition now being held at the Science Museum, South Kensington. The exhibition has been organized by the Society of Glass Technology with the support of the Glass Research Delegacy, and is the outcome of an invitation extended to the Society by Sir Henry Lyons, Director of the Science Museum. The purpose is to illustrate developments which are either the results of or have largely been influenced by modern research in glass technology.

The gallery reserved for this exhibition does not afford sufficient space to meet the requirements of so great a field as that which modern glass technology has touched, but the Committee which has been working for some time on the subject has made a judicious selection of material. The exhibition contains numerous specimens which illustrate the various physical and chemical properties which have been developed in the search for new and improved materials for optical, illumination and other purposes. The methods of the research worker are explained as simply as possible by descriptions, diagrams and actual apparatus, and there are a series of photographs of processes in glassworks. Certain finished products are shown in order to illustrate a little more fully the number of uses to which glass is put.

The exhibition was opened on 21st October by Sir Richard Gregory, and will remain open until the end of the year. An opportunity to hear about the many developments which have taken place in recent years is provided by a series of weekly lectures, on Thursdays at 4.45 p.m., by well-known authorities. " Modern Artistic Glass " was the subject of the first of the lectures, delivered by Professor W. E. S. Turner on 22nd October. The subjects of further lectures include : The electric lamp, coloured glass and coloured light, and fused silica among many other important aspects.

The December issue of *Discovery* will contain an article on " Recent Research in Glass Making," with special reference to the exhibition at the Science Museum.

Plant Hunting in Serbia.

By P. L. Giuseppi.

Many rare plants were discovered by the author in the course of a recent trip through Serbia. The collection includes a little-known species of primula which has been out of cultivation for over thirty years.

We arrived at the village of Rostusa late in the evening. We were looking forward to climbing Korab from this village, which is situated on its eastern slopes, but we were soon undeceived and told that we must go on to Zeranic for permission; here we wasted at least three hours in an unending series of telephone messages to all sorts of military authorities until we gave up the attempt in despair and fled in our car to Shkoplje, for permission. The frontier between Yugoslavia and Albania is closely guarded, and no one is allowed to approach from the Serbian side without permission; in only three places is a car allowed to pass. On the Albanian side, on the other hand, one can approach it to one's heart's content. On the way to Shkoplje the scenery is very grand, and continually one is astonished to see magnificent mountains with summits still clad with snow.

GERANIUM ON KORAB.

Geranium subcaulescens literally grows in tens of thousands in the turf.

We stopped on the way at the gorge of the Treska river to collect ramondia (*R. Nathaliae*). The river completely fills up the gorge, and it is impossible to enter it without a boat. One can only stare at the ramondias in helpless fury. To get to the foot of the sheer limestone precipices on each side of the gorge is a ticklish and thorny proposition, but still it was done, and at last, perched in awkward positions, one was engaged in removing large clumps of this rare ramondia from these rocky cliffs. The distribution of nathaliae is a peculiar one. It is restricted to an area lying in the centre of Yugoslavia, and is entirely surrounded by an area in which only the Serbian species (*R. Serbica*) is found. In Albania and North Greece only *R. serbica* is found. According to Koshanin, the only difference between the two is in the shape of the leaves, for whereas the leaves of nathaliae have regular edges and are more rounded, the leaves of Serbica have irregular edges and are more quadrangular in shape. Gone are the supposed differences in numbers of petals and hairiness. In my opinion the shape of the leaves and their indentations are also largely imaginary. The only difference which I can see is in the colour of the leaves, which in nathaliae are of a darker, more shiny colour, whereas in serbica the leaves are of a lighter green and are duller. The difference is a marked one, and is easily recognized even at a distance. I find that both ramondias are easy to cultivate. As soon as we arrived at Shkoplje I called on the colonel in charge of the frontiers. He at once telephoned to Belgrade for permission and promised an answer on our return from Ljubeten. On our return from that mountain I was asked to speak to the general, who at once said that not only was permission given to us to go anywhere we wanted on the frontier, but that horses and soldiers would be provided, and that we would be allowed to sleep at the frontier stations and would be given food. This is typical of the generosity of the Serbs; wherever we went in Yugoslavia we were surprised at the generous treatment meted out to us by complete strangers. We returned in great glee to Zeranic. This is a charming village right up in the hills in a delightful situation. Most of the houses have the broad eaves so typical of Bulgarian architecture and so common in Ochrida. The narrow lanes in the town are very picturesque. Soon we were provided with three horses and were off, accompanied by our guide and two soldiers. The roofs of the village houses were of stone, and looking down on the village most delightful views were afforded us.

After riding through many fields, we began to ascend through woods which occupied narrow valleys,

and at last we were rewarded by a glorious view of the frontier range. The mountains here are beautifully green, and have much snow still on their summits. The geranium (*G. subcaulescens*) literally grows in tens of thousands in the turf, tall verbascums, a beautiful silene, many campanulas, and thousands of other flowers grow in profusion. At 8 a.m. we arrived at the frontier post of Skertats and were welcomed by the officer in charge. The post is at 6,700 feet. We were given the officer's hut, a square stone building with walls at least a yard thick, and with only one tiny square window.

The post had been raided the previous night and many sheep stolen. During the whole night a sentry walked round our hut. We were awakened early in the morning by the extreme cold, and on looking out we discovered a thick mist and that it was raining heavily. The station was situated at the very frontier on a low col, and consisted of three buildings. We spent the morning under shelter, and at about 3 p.m. we started off for the summit of one of the peaks of Korab. On the way up the mist was so thick that we were compelled to build cairns. We collected many beautiful specimens. There were so many flowers that the fields were a blaze of glory. Finally at 7,700 feet I found on the Albanian slopes of a frontier col and in the valley below at the edge of the melting snows *Androsace hedreantha*, a family of small Alpine plants. The ground was pink with the glorious pink flowers of this rare plant. The leaves are smooth, oval, pointed, and of a very deep green. The flowers vary in their colour from white to pink, and are very large for the size of the plant. Some of the clumps were quite five inches in diameter. It is a curious fact that this plant is only found on the Korab chain and the Rilo in Belgrade. On the way down the mist cleared and we decided to return to Zeranic that night. We walked down in two and a half hours, arriving wet through at 9.30 p.m.

Next day we left in the car for Nichipur, and when we arrived at the ford we found the soldiers, to whom we had telephoned the previous day, waiting for us. The torrent had to be crossed on a narrow trunk—no easy work—and we were soon again on horseback on the way to Nichipur. Here we were welcomed by the officers, and found to our horror that the mountain to which we were being taken, Cuseli, was not on the frontier, but well within Yugoslavia, and quite a low mountain. The officers very kindly brought out their map and I was able to find on it the correct name of the mountain to which we wished to go, Kapa Jamit. It was a good thing that I had carefully studied the map of the Hungarian expedition, as otherwise the trip would have been futile.

Our path took us high above a torrent and then up and down through deserted valleys with excellent pasture, but with no inhabitants, for since the Albanians raided and destroyed the two villages in these valleys no one has been allowed to live in these dangerous parts. The views of Small Korab and the Korab chain were extremely fine. At last our path took us over a high mountain of about 7,100 feet and then along the side of a nameless mountain of about 8,700 feet to a low col which is here the frontier between Yugoslavia and Albania. The col is about a mile in length, and on the other side rises Kapa Jamit, a lower mountain, than the nameless one. On the col are two frontier posts. On the Albanian side a village can be seen down in the valley, otherwise all is solitude. On the Serbian side all is wild. Around the melting snow in schistic soil *Androsace hedreantha* was flowering in hundreds, and higher up the mountain we found a species of ranunculus (*R. Wottsteinii*) growing in loose, shaly soil in thousands. This ranunculus resembles narcissiflora, but the leaves are pinnate and much more handsome. The flowers are white. Our search had come to a successful end, and noticing the growing anxiety of the soldier who had accompanied me I returned at 8 p.m. to the nearest post. The post is surrounded by earthen ramparts, and an evident state of war exists.

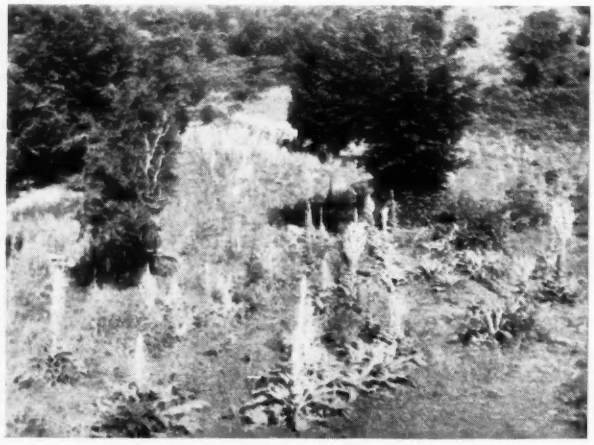
The soldiers received us right royally, at once giving us two of

EDRAIANTHUS IN THE BOSNIAN MOUNTAINS.

Edraianthus niveus was found in full flower at a height of 6,700 feet in the Bosnian mountains of Krstac.

their beds. Fortunately for me, one soldier spoke Albanian, so that I could converse a little with them. Here, as always, the Serbian soldiers, who were our hosts, were charming to us, feeding us at their own expense and receiving us with evident pleasure, but in no single instance did a single soldier accept a tip. On the night we spent near Kapa Jamit there was a full moon, and a glorious sight it was to see the mountains bathed in the white light. Next morning we parted regretfully from our delightful hosts and returned the way we had come to civilization.

About a year ago I first heard of the existence of the species of edraianthus known as *E. niveus*, which was discovered by Beck in 1893, but for a long time I was unable to get any details of the locality in which this rare plant grew. At last I found out that it grew on the Bosnian Mountains of Krstac, and soon I was able to locate the mountain on a map at the Royal Geographical Society. Krstac is composed of a chain about seven miles long of peaks of a uniform height of about 7,500 feet, and very quickly the mountain sheers away into the neighbouring and lower hills. It is a long way from England to Fojnica, and even at Fojnica one's troubles are not at an end, for it still requires at least six hours on horseback to get to the chain.



A COLONY OF TALL VERBASCUMS.

Tall verbascums grow in profusion among thousands of other flowers in the Korab chain.

Fojnica is a typical Bosnian village of wooden roofs. On our arrival we found that the only hotel was full, but after some trouble we found a woman who was willing to give us three beds in her house. We had a poor meal served in the inn, and at 4.45 next morning our horses arrived, and we were off at last. We first followed a river, then up hills and over Alpine meadows, then through very fine and thick woods to our mountain. The path we took was a busy one and led us past much cultivation, many houses, and through one village. It was most interesting to see the Slav at work in his field, and to see how interested he was in our trip. In the thick wood were a good many crocuses in seed, growing in the densest shade, and I wondered what this crocus would turn out to be. The mountain chain appeared to be entirely of granite, and on leaving the wood we were very interested to see what plants we would find on the open mountainside. Saxifrage (*S. porophylla*) grows in very fine clumps just on the outskirts of the wood, and a little higher we passed through a curious little wood of dwarf pines. The trees were bent in all directions with the wind, and gave one the impression of a fairy wood. On huge boulders of granite grew a peculiar sempervivum, resembling to some extent the soft red variety, *S. calcareum*. The flora was distinctly poor, but after climbing to a shoulder at 6,700 feet I found *Edraianthus niveus* in full flower on an outcrop of limestone forming a scree. Between the loose rocks of this scree the huge white trumpets were pointing to the skies, and looked very charming, in the bright sun. The leaves are needle-shaped and light green in colour. The flowers are about an inch and a half long and about half an inch across the trumpet, and many are packed closely together. The tap root is very long and takes a good deal of excavating. Though I found several other screes of exactly the same formation, I never saw another plant outside this scree. There were not many plants on the scree, and I should imagine that the species is extremely rare. The summit of the highest peak is composed of large granite blocks, and not a sign of the plant could be found here. We descended to the shores of a delightful tarn, on the shores of which the shepherds have their summer houses. Here we were treated to sour milk, and after a short rest started homewards. The only other plants worth noting were a pinguicula and a soldanella, a species allied to the American cowslip.

Our holiday ended on Prenj, as it had done last year. We hurried to Jablanitza in our car from Fojnica, and here, curiously enough, we were again able to get only one horse, as in the previous year. From Jablanitza to the foot of Prenj is a long walk, and in the broiling sun it was anything but a pleasure. The path up the mountain has been greatly improved

since last year, but the first part is as uninteresting as ever, the one joy being the views of the wonderful precipitous summit of Prenj. We soon found campanula (*Cherzegovensis*), a very beautiful saxatile plant, and very difficult to collect. The plants form little bushlets about four inches to six inches high, with the wiry stems crowded with beautiful blue bells. The rocks in places were crowded with this campanula ; *saxifraga porophylla* and the evergreen species (*aizoon*) were also common. There were also two irises, one a very large saxatile iris similar to the one collected in the gorge on the way to Smolika, and not in flower, the other with long leaves so like grass that it was difficult to distinguish it. The woods through which the path led were very fine, but the plants became most uninteresting, though on the outskirts of one wood we found the first *primula kitaibeliana* we had seen since last year. As we climbed ever higher darkness fell, and away in the distance we could hear the baying of wolves, which caused us to hasten our steps. At last we arrived at the hut, where we were welcomed by about thirty workmen who were employed in making up the path. The hut consisted of two rooms, one a large room with a huge fireplace, on which a stew was being prepared, but with no chimney, and the other a small room with two beds covered with straw. This room was at once given us. Above the rooms was a loft in which most of the men slept. We picketed our horses and had our dinner of tinned foods while we awaited the arrival of our old horseman, a man of about seventy-five, who eventually arrived an hour after us. The men were devout Mahommedans and said their prayers outside, facing the east. After dinner the men sat round the fire and amused themselves by telling stories, chanting in one note, and singing songs. They were handsome and well-built men, and were very interested in us. Going to bed consisted simply in lying down and covering oneself with a coat. We started at about 5.30 next morning, and were soon collecting interesting plants, among them a colchicum, or meadow saffron, a crocus, then a small Alpine plant, *Androsace villosa*, which we found carpeting the limestone screes with its beautiful white rosettes. On the huge limestone boulders were clumps of the beautiful hoary-white curquefoil (*Potentilla deorum*) with large white flowers. The plant was so saxatile and the trunks so old that it was quite impossible to prise out a single plant with roots.

Further up still the northern faces of the rocks were covered with *Primula kitaibeliana*. This rare species, which has been out of cultivation for some thirty years, was rediscovered by me last year in a huge katavothron at least two hundred feet in depth with steep sides. The bottom was covered with huge blocks of limestone, which made walking extremely dangerous, and made one feel like a fly walking over lumps of sugar. At the very bottom was a huge drift of snow, and on the ledges facing north were colonies of this primula occupying every available inch. The leaves gave a curious odour when bruised. The flowers are of a deep purple colour. The plant seems quite hardy in cultivation, and it is to be hoped that it will flower freely. As we came down the mountain we met the gangs of workmen busily improving the paths, and their friendly salute, " dobar dan," or good day, will re-echo in my ears for many a day.

IN THE KORAB CHAIN.

The mountain path led up and down through deserted valleys with excellent pasture.

It was an exceedingly hot day and we arrived at our hotel in a very tired condition. The journey northwards was highly interesting, taking us as it did through Bosnian villages with their high-pitched wooden houses and mosques. The mountains were extremely bare. *Drypis spinosa* was particularly beautiful, however, and it is a pity that this delightful plant with its exquisite pink flowers is not more common in our gardens. But curiously enough it is very local even where it is found. Another very interesting plant was *Iris attica var primula*, which I discovered on uncultivated ground about thirty miles outside Zara. Here the plant grew in drifts in a very limited area.

A Neglected Island in the Danube.

By J. E. Pryde-Hughes, F.R.A.I.

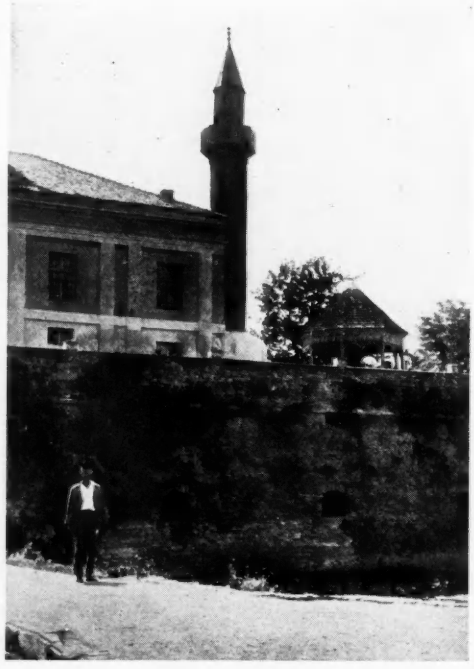
The author is among the few Europeans to have visited the picturesque island of Ada Kaleh which lies in the centre of the Danube between Rumania and Serbia. Once an important fortification, this island is now chiefly the home of a backward people whose houses are built of wood and tin salvaged from the river.

SAILING down the Danube every bend and cliff, after passing Porta Hungarica, brings a reminder of the tremendous invasion of the Turks in the Middle Ages, when their conquering armies were only held at the very doors of Vienna. It may be a town, like Esztergom, the centre of Hungarian religious life where, according to tradition, the first King of Hungary was born, and which changed hands time and again in the Magyar-Turk struggle. The town still bears marks of those stern days, though the cathedral on the cliff looks serene enough, and really this majestic building is of comparatively modern date. It may be Buda, where, on this side of the river at Budapest, the ramparts of the Turks come down to the water's edge, to-day enclosing delightful walks and gardens. The ramparts are built on much older foundations, for Buda has had a military career from its beginnings at the opening of our Era. Or it may be a castle, a monument, or minaret.

Passing out through the great Hungarian plain, signs of the Turks become frequent for those who care to seek. At Mohacs, in 1526, the great battle between the invaders and home defenders took place, when the host of Magyar chivalry went down before the victorious hordes of Islam; and only a few miles off the river is the university town of Pecs, which sent its patriotic students into the melee. There is an old Turkish mosque at Pecs, now the parish church.

Castles which stood up to the Turks line the shores, the mighty Peterwardein opposite Novisad among others, and just before Belgrade comes Zemun, at the mouth of the Save, where John Hunyadi, the greatest of Magyar warriors, died at his castle after his victory at Belgrade in 1456.

From Belgrade the rocky channel of the river and the stark cliffs of the Greben and Kazan defiles were obstacles which tested the metal of invaders from the east, as in Roman days they tested the ability of the engineers of the legions advancing eastward to the conquest of Dacia. These Roman pioneers cut a road in the face of the rock, and at one place in the Kazan defile they actually hung the road over the water. There, where the steep cliffs rise sheer out of the rapid current, holes were chiselled out to receive baulks of timber on which the roadway was laid, and by way of this precarious passage the armies progressed. This is on the Serbian side. In the last century, the Hungarians built a road on what is now the Rumanian side, the famous Szechenyi road; the Hungarians also regulated the course of the stream, to the benefit of navigation.



MINARET OF THE MOSQUE.

A scene in the quaint Turkish island in the Danube at the entrance to the Iron Gates, rarely visited by the outside world.

As one comes out of the Kazan defile, the shores of the river take on a milder aspect and the town of Orsova is the first stopping place. Orsova was my objective, or rather it was the only place I could use as a base from which to get to Ada Kaleh, the picturesque Turkish island which lies in the middle of the river between Rumania and Serbia, at the mouth of the Iron Gates. No boats stop at Ada Kaleh, though they may pause opposite it in mid-stream, awaiting the fall

ADA KALEH.
A view inside the fortifications, seen from the mosque.

of the black navigation ball ahead, which announces that the channel of the Iron Gates is clear. So, to reach the island one must bargain with a Turkish boatman to take one across the stream in a roughly built craft.

About a mile long and not quite so broad, Ada Kaleh is typically Turkish. A mosque crowns a slight rise in the centre of the island; the women all wear shawls over their heads and some still wear the veil, while the fez is the common headgear of the men. To-day the fortification, which spread all over the island, are crumbling to pieces, with yawning gaps bridged by vegetation and kitchen gardens where once armed men assembled. The fortifications must have been powerful in their day: the walls of brick are massive and are built all round and across the island. Now fruit trees and flowers usurp the drilling squares and warriors' posts. The village is tucked away inside, but many villas have sprung up in nooks near the water's edge. Most of these are inhabited by conservative Turkish families, some of whom came here from Anatolia to escape the modernizing of Kemal Pasha. On the side of the island facing Serbia the fortifications were built with recesses and a long tunnel for fighting men and reserves. In these recesses fugitives from Albania have taken up their abode, building up dark and dingy homes with pieces of tin and wood salvaged from the river and the rubbish dump; these homes are more primitive than the kraals of central Africa.

Ada Kaleh in the Middle Ages was an important centre. The Austrian general, Heister, fortified the island in 1689, but in spite of its immense strength the Turkish captured it and, realizing its value in the wars of those times, re-fortified it for their own use. After the Treaty of Passarovicz, it passed once more into the hands of the Hungarians, and Charles III of Hungary had a great fortress erected which is now in ruin. The Turks again took possession until 1878, when, after the Russo-Turkish war, the Austro-Hungarian Empire adopted the island at the request of the Sultan, and the Turkish population was taken under its protection; though the people always retained their independent Turkish character.

After the Great War Rumania took over Orsova, which was the frontier of the Austro-Hungarian Empire, and also Mount Allion, at the foot of which there is a little chapel marking the spot where the Hungarian royal crown and insignia were buried during the troublous times between August 1849 and September 1853. At the same time Rumania quietly annexed Ada Kaleh. No attempt appears to have been made to impose Rumanian culture on the inhabitants, who remain typically Turkish in every way, though the ancient characteristics and strength of faith appear to be weakening. The customs laws are relaxed here, and perhaps it is as well for the Ada Kalehians of old had a great reputation as smugglers of tobacco and other Turkish products brought up the river from Constantinople and Anatolia. This, a century or so ago, was apparently the chief industry of Ada Kaleh, with as a pastime some fishing near the Iron Gates where it is said the sturgeon come up to rub their itching backs and flanks on the jagged rock ledges. To-day the Turks here live by some gardening and fruit cultivation, a little cigar manufacture, the preparation of rahat ("Turkish Delight"), and mild catering for the few individuals who visit the island.

THE OLD FORTIFICATIONS.
A break in the massive wall, looking towards Serbia.

London Celebrates a Century of Science.

By A Special Correspondent.

The British Association centenary meeting, the Faraday Exhibition and the Illumination Congress have marked a striking close to a century of scientific progress. In his Presidential Address General Smuts declared that science is at last coming into its own as one of the supreme goods of the human race.

THE centenary meeting of the British Association opened with an address that set an exceptionally high standard for the week's proceedings. Every day brought some item of outstanding interest. Seldom have so many leaders of thought taken part in a single discussion as on 29th September, when "The Evolution of the Universe" was the subject before the Mathematics and Physics Section. The demand for seats on this occasion was so large that at the last minute the meeting had to be transferred to the Central Hall, Westminster.

While the membership reached a record total this year, the centenary celebrations were somewhat obscured by the political crisis. This also applied to the Faraday centenary and to the International Illumination Congress, which brought visitors to London from all parts of the world. In the ordinary way these meetings would have provided welcome "copy" for the newspapers, with headlines for quite unimportant matters; as it was, even the presidential address had to appear on a back page this year.

Fortunately the floodlighting of the chief buildings attracted great public attention. It was estimated that larger crowds were in the streets on the first evening than collected even on Armistice Night in 1918. The traffic was held up for some hours in Whitehall and all the approaches to Buckingham Palace were densely crowded. Although this magnificent display was not an official part of the Faraday celebrations, it served more than anything else to bring home the benefits of his great discovery, as high-power lighting depends, of course, on electro-magnetic induction.

The History of Electricity.

This and other results of Faraday's work were shown at the Albert Hall from 23rd September to 3rd October, when an exhibition illustrating the history of electricity was visited by over 50,000 people. In the centre of the great hall was a life-size statue of Faraday, standing on a dais surrounded by his notebooks and apparatus, including the diary in which he recorded his momentous discovery on 29th August, 1831. On that date, after years of patient experiment, Faraday observed that when he moved a magnetized bar through a coil connected to a galvanometer, a current was generated in the coil. This simple observation led to the first dynamo and opened up the era of electricity and all its great developments.

Our Debt to Faraday.

A replica of Faraday's laboratory at the Royal Institution was erected in an upper floor of the Albert Hall. To step from this simple room on to the balcony and gaze down on the immense results of his experiments, gave an almost staggering impression of what the world owes to Faraday. Round his statue the exhibits were arranged radially, the inner circle of stands showing Faraday's work on magnetism, chemistry, etc., and the outer stands continuing their history down to the present day. Electric power, wireless, electricity in the home and lamp manufacture were among these sections, which included working machinery and an automatic telephone exchange.

This great exhibition was chosen as the setting for the opening of the British Association meeting. On 23rd September Professor F. O. Bower, the retiring President, took the chair at the Albert Hall and welcomed his successor, General Smuts—"lawyer, soldier, statesman and philosophical exponent of scientific theory." A reception of British and foreign delegates was then held, the first visitor to mount the platform being appropriately Mr. S. Walker, of the Yorkshire Philosophical Society, representing the city where the British Association had first met a century ago.

In his inaugural speech General Smuts said that the Association had run a course not unlike that of the Empire. It had become the parent of smaller science associations in most of the dominions, and this centenary meeting was a great family reunion. The Association had been an effective sounding board of scientific progress. Great controversies were fought out at its meetings, like that over Darwin's theory, and great discoveries were announced. "Here Joule explained his epoch-making researches into the mechanical equivalent of heat; here Rayleigh and Ramsay announced the discovery of argon which led

to the discovery of the other inert elements; here Fitzgerald first announced Hertz's verification of Clerk Maxwell's theory of electro-magnetic waves; here Sir Oliver Lodge gave the first public demonstration of wireless; most epoch-making of all, here Sir Joseph Thomson announced his discovery of the electron." The list could be greatly extended.

Like to-day 1831 was a time of great economic and political confusion and unsettlement. The situation sixteen years after the Napoleonic Wars was not very different from the situation now, thirteen years after the Great War, although the mischiefs of to-day reach farther and go much deeper. It was, like ours, a time of transition from one era, from one order of things to another, with all the dislocation and unrest and social suffering which such a transition implies. Men could not then foresee the great Victorian era on whose threshold they were already standing, and they were filled with fears and dark forebodings of the future. The agitation which led to the great Reform Act the following year had reached its climax.

The prospects of British science no less than of British industry appeared sombre even to those best informed. Sir David Brewster, perhaps the leading figure in the British science of that day, painted in that year a gloomy picture of England alone among the nations lagging behind in the race of recovery and reconstruction.

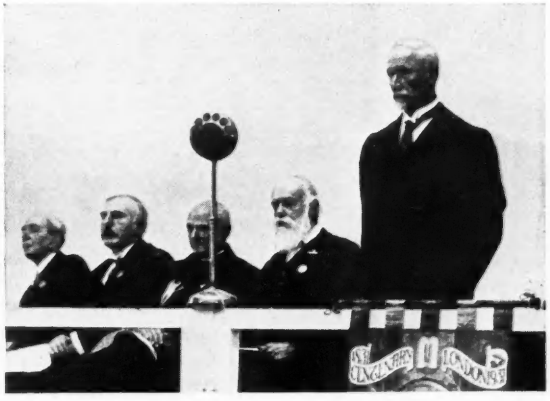
But the situation was not really as black as it was painted; it never is. Science was definitely coming on the scene as a force to be reckoned with. At the very time of Brewster's jeremiad Michael Faraday was successfully solving the principle of the dynamo, and thereby opening up a source of power which was to revolutionize the industries of the future. In that year also, and largely on the initiative of Brewster himself, this Association for the Advancement of Science was founded.

At the darkest hour before the dawn science thus came forward as the new reinforcement, the great new factor in the economic reconstruction of the world, and the immense material progress of the nineteenth century has been largely due to it. Drawing the parallel for to-day, one may hesitate about the next step in political development, but there is no room for doubt that science, now even more than in 1831, is the dominant factor in the industrial and economic revival.

In conclusion the President stressed what he wrote in *Discovery* last month, that "in the penetration of science into all avenues of human activity lies our main hope of future advance."

This view was elaborated the same evening (23rd September) at the Central Hall, where General Smuts delivered his Presidential Address to the British Association. His subject was the "Scientific World Picture of To-day," and as one brilliant statement followed another in rapid succession, the audience was left breathless with admiration.

The majority of thinking people have felt for some time that recent discoveries in science have tended to confirm the reality of spiritual values. The President's address made a clear case for this view, showing that materialism must now go by the board and that the new century is beginning with a fresh and encouraging outlook. In place of the hopeless picture suggested by certain astronomers in which life is "accidental" and its fate sealed with the inevitable running down of the solar system, General Smuts suggested that in life and mind "Nature seems to have discovered a secret which enables her to irradiate with imperishable glory the decay to which she seems physically doomed."



GENERAL SMUTS SPEAKING AT THE ALBERT HALL.

On the right of General Smuts are Sir Oliver Lodge and Lord Rutherford.

The conclusion was thus that physics and biology are simpler and more advanced forms of the same fundamental pattern in world-structure. Full quotation of the address is impossible here, but the following extracts give its main theme :—

The acceptance of the theory of evolution has brought about a far-reaching change in our outlook on the universe and our sense of values. The story of Creation, so intimately associated with the groundwork of most religions, has thus come to be rewritten. The unity and interconnexions of life in all its manifold forms have been clearly recognized. And man himself has had to come down from his privileged position among the angels and take his proper place in the universe as part of the order of Nature.

Space-time finds its natural completion in organic evolution. For in organic evolution the time aspect of the world finds its most authentic expression. The world truly becomes process, where nothing ever remains the same or is a duplicate of anything else, but a growing, gathering, creative stream of unique events rolls forever forward.

But while we recognize this intimate connexion between the conceptions of space-time and organic evolution, we should be careful not to identify the time of evolution with that of space-time. There is a very real difference between them. Biological time has direction, passes from the past to the future, and is therefore historical. It corresponds to the "before" and "after" of our conscious experience. Physical time as an aspect of space-time is neutral as regards direction. It is space-like and may be plus or minus, but does not distinguish

between past or future. It may move in either direction, backward or forwards, while biological time, like the time of experience, knows only a forward flow. Hence cosmic evolution, as we see it in astronomy and physics, is mostly in an opposite direction to that of organic evolution. While biological time on the whole shows a forward movement towards ever higher organization and rising qualities throughout the geological ages, the process of the physical world is mostly in the opposite direction—towards disorganization, disintegration of more complex structures, and dissipation of energy.

While the smaller world of life seems, on the whole, to be on the up-grade, the larger physical universe is on the down-grade. One may say that in the universe we witness a majority movement downward and a minority movement upward. The energy which is being dissipated by the decay of physical structure is being partly taken up and organized into life structures—at any rate on this planet. Life and mind thus appear as products of the cosmic decline and arise like the phoenix from the ashes of a universe radiating itself away. In them Nature seems to have discovered a secret which enables her to irradiate with imperishable glory the decay to which she seems physically doomed.

The Nature of Life.

Organic evolution describes the specific process of what we call life. When we ask what is the nature of life we are curiously reminded of the behaviour of the quantum. I do not wish to say that the quantum is the physical basis of life, but I do say that in the quantum the physical world offers an analogy to life at least suggestive. The quantum follows the all-or-nothing law and behaves as an indivisible whole; so does life. A part of a quantum is not something less than a quantum; it is nothing, or sheer nonentity; the same holds true of life. The quantum is perhaps most easily symbolized as a wave or combination of waves which can only exist as a complete periodicity and whose very concept negatives its existence as partial or truncated. In other words, it is a specific configuration and can only exist as such; the same holds true of life. Apparently the quantum does not fall completely within the causal deterministic scheme; the same is true of life. Life is not an entity, physical or other. It is a type of organization; it is a specific principle of central or self organization. If that organization is interfered with we are left, not with bits of life, but with death. The nature of living things is determined not by the nature of their parts but by the nature or principle of their organization. In short, the quantum and life seem to have this in common, that they both behave as wholes.

General Smuts proceeded to show how this concept of the whole applies not only to life but to the ultimate physical units. In life a whole is not a sum of parts; its nature lies in its constitution, the part in the whole being no longer the same as the part in isolation. According to recent discoveries in physics, this is also true of the electron.

The electron within an atom is no longer a distinct electron. There may be separate electrons, but when they cease to be separate they also cease to be. The eight electrons which circulate in an oxygen atom are merged in a whole in such a way that they have lost their separate identity; and this loss of individuality has to be taken into account in calculations as to the physical behaviour of the atom. The physicist, in fact, finds himself unable to look upon the entity which is one-eighth of eight electrons as the same thing as a single electron.

At the very foundation, therefore, of physics the principle or category of the whole applies no less than in the advanced structure of life, although not in the same degree. In the ultimate analysis of the world, both at the physical and the biological level, the part or unit element somehow becomes shadowy and incoherent, and the very basis of mechanism is undermined. It would almost seem as if the world in its very essence is holistic, and as if the notion of individual parts is a practical makeshift without final validity in the nature of things.

The general trend of the recent advances in physics has thus been towards the recognition of the fundamental organic character of the material world. Physics and biology are beginning to look not so utterly unlike each other. Hitherto the great gulf in nature has lain between the material and the vital, between inorganic matter and life. This gulf is now in process of being bridged. The new physics, in dissolving the material world of common sense, has disclosed fundamental features which it has in common with the organic world. Stuff-like entities have disappeared and have been replaced by space-time configurations, whose nature depends on organization. And this principle, which I have called holism, appears to be identical with that which pervades the organic structures of the world of life. Physics and biology are thus simpler and more advanced forms of the same fundamental pattern in world-structure.

Having dealt with life and matter in his "science picture," the President explained that the next step was to show that mind is an even more potent embodiment of the organizing whole-making principle. This embodiment has found expression in a rising series, which begins practically on the lowest levels of life and rises ultimately to the conscious mind.

Mind, even more than life, is a principle of whole-making. It differentiates, discriminates, and selects from its vague experience, and fashions and correlates the resulting features into more or less stable, enduring wholes. Beginning as mere blind tropisms, reflexes, and conditioned reflexes, mind in organic nature has advanced step by step in its creative march until in man it has become nature's supreme organ of understanding, endeavour, and control—not merely a subjective human organ, but nature's own power of self-illumination and self-mastery: "the eye with which the universe beholds itself and knows itself divine."

A World of Patterns.

The free creativeness of mind is possible because the world ultimately consists, not of material stuff, but of patterns, of organization, the evolution of which involves no absolute creation of an alien world of material from nothing. The purely structural character of reality thus helps to render possible and intelligible the free creativeness of life and mind, and accounts for the unlimited wealth of fresh patterns which mind freely creates on the basis of the existing physical patterns.

The highest reach of this creative process is seen in the realm of values, which is the product of the human mind. Great as is the physical universe which confronts us as a given fact, no less great is our reading and evaluation of it in the world

FLOODLIGHTING OF LONDON.

The International Illumination Congress brought visitors from all parts of the world. The photographs show: 1.—The Foreign Office. 2.—Somerset House. 3.—The *President* on the Thames. 4.—St. Martin's-in-the-Fields. 5.—The Tower of London.

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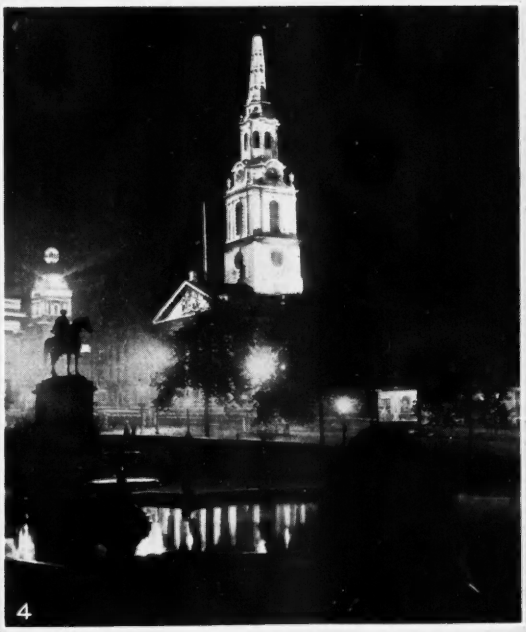

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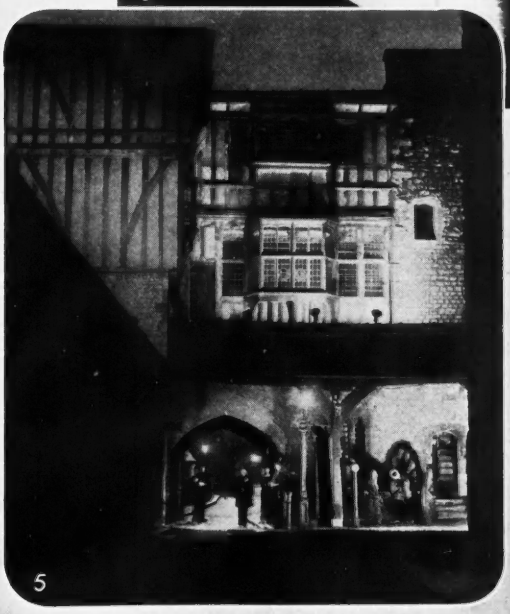

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of values, as seen in language, literature, culture, civilization, society and the State, law, architecture, art, science, morals and religion. Without this revelation of inner meaning and significance the external physical universe would be but an immense empty shell or crumpled surface. The brute fact here receives its meaning, and a new world arises which gives to nature whatever significance it has.

Among the human values thus created science ranks with art and religion. In its selfless pursuit of truth, in its vision of order and beauty, it partakes of the quality of both. More and more it is beginning to make a profound aesthetic and religious appeal to thinking people. Indeed, it may fairly be said that science is perhaps the clearest revelation of God to our age. Science is at last coming into its own as one of the supreme goods of the human race.

The Duty of Science.

While religion, art and science are still separate values, they may not always remain such. Indeed, one of the greatest tasks before the human race will be to link up science with ethical values, and thus to remove grave dangers threatening our future. A serious lag has already developed between our rapid scientific advance and our stationary ethical development, a lag which has already found expression in the greatest tragedy of history. Science must itself help to close this dangerous gap in our advance which threatens the disruption of our civilization and the decay of our species, and may be destined to become the most effective drive towards ethical values, and in that way to render its most priceless human service.

Some of the questions raised by General Smuts were dealt with in more detail at a subsequent meeting of the Mathematics and Physics Section. The company that took part on this occasion, as already mentioned, provided a most brilliant discussion on "The Evolution of the Universe." The views of science were advanced by Sir James Jeans, Professor E. A. Milne, Sir Arthur Eddington and Professor R. A. Millikan, the discoverer of cosmic rays. The standpoint of the philosophers was expressed by General Smuts, Dr. Barnes (Bishop of Birmingham) and Professor L'Abbé Lemaître. In opening the subject Sir James Jeans explained that he, at any rate, was "only discussing the physical universe where strict causal determination prevailed." Later Dr. Barnes voiced a protest against the current theory of the collision origin of planetary systems "which made consciousness the by-product of an accident."

Sir Oliver Lodge summed up the discussion at the request of the Astronomer-Royal. He said* that most of the speakers seemed to answer "Yes" to Sir James Jeans's question: "Is matter being annihilated?" Professor Millikan said "No, it is rather a building up of matter that is going on. Cosmic rays show us the signs of hydrogen turning into helium." That would give a certain amount of radiation, but whether it would be sufficient for the production of what we perceived in the universe is still a question.

Now all these arguments are advanced on the assumption that the physical universe is the result of itself—simply a physical and chemical process. If Sir James Jeans has arrived at the conclusion that we are living on an ash-heap of a world which is just the remains of what has been a scene of great activity, but has now settled down into sobriety and stupidity; and that life has come as a kind of disease afflicting matter in its old age—if he has arrived at some such or other depressing kind of conclusion—we must remember that these are mere physical data.

The Bishop of Birmingham took us into a higher region when he, though a mathematician, argued that there were things that had been left out. I agree. Anything ignoring any elements of the problem is incomplete and liable to a breakdown. Physics cannot take the whole of the universe into account. . . . I claim as a physicist that too much attention has been paid to the second law of thermodynamics, and that the declaration of the final and inevitable increase of entropy to a maximum is a bugbear, an idol, to which philosophers will not bow the knee. It is instructive to learn from high and competent authorities what the unadulterated or rather unvivified laws of physics applied to the universe will lead to—a steady degradation of energy to a predetermined end, without hope of novelty, all settled and dull events just going through the hollow form of taking place.

But this is all on the assumption that there is nothing or no one to wind it up or to guide it to some nobler end. Guidance has only recently intruded itself into the scheme of physics, but already there are guiding waves which determine the path of a particle of matter. Whatever the significance of those waves may be, whether they have any connexion with life and mind, is at present unanswered. To philosophize from a restricted point of view is interesting enough, but it is not conclusive. It does not fully account for the state of the world to-day, nor can it be depended on to formulate its course to-morrow.

At the beginning of this new century of the British Association we have turned our attention from Newtonian matter and the forces acting on it to the spaces between the particles of matter, where the activity is. With Einstein has begun a new era, but we have not got very far yet. The Bishop of Birmingham does not like a chance theory of the origin of the earth, because it would make life and mind so trivial, but if we attend to space properly we shall find it is not only on lumps of matter that we find life and mind. Intelligence and mind can be found throughout space; that is what we are coming to, and after a time we shall be led to the further conclusion that life and mind are more important than the material universe or any of the things we have been discussing this morning.

*Quoted from the full report in *The Times*.

The Voyage of "Discovery II."

In Dr. N. A. Mackintosh's article, "With the Discovery II in the Antarctic," a sentence was inadvertently omitted on page 317. The sentence, which should have followed line seven, was as follows: "During the voyage home we took the opportunity of working a line of thirty-two stations from a point near the Sandwich group all the way up the thirtieth meridian to St. Vincent."

Modern Gliding and its Future.

By E. C. Gordon England.

Chairman of the British Gliding Association.

The lessons learned in the sailplane have already proved of great assistance to the progress of aviation. One of the pioneers of the gliding movement here describes recent developments in this branch of aeronautics.

CONTRARY to the general belief, gliding and soaring as we know it to-day is not a new activity. Gliding was, in fact, the means employed to test their theories by the earliest investigators of human flight, and it was the means by which the famous Wright brothers learned the fundamentals of aeroplane control. In this way they taught themselves to fly an aircraft satisfactorily before installing any motive power in their machine.

Undoubtedly it was this fact that enabled them to make such steady progress and ultimately to triumph without a single serious set-back over a period of several years. Before the Wright brothers, earlier pioneers such as Sir George Caley, Stringfellow, Pilcher and Lilienthal, had all made use of gliders either in model form or as full scale man-lifting machines. Thus the glider is the oldest known practical means of effecting human flight.

The truth of the statement that history repeats itself is so often being proved by the march of events that there is nothing particularly remarkable in this aspect of gliding. What is remarkable is that so few people seem to have grasped the significance of these signs of the times. The wonderful results obtained by the Wright brothers was due to their keen appreciation of the fact that the first essential to the conquest of the air is a proper understanding of the medium in which one proposes to operate, and an appreciation of the essential requirements of control. Their achievements were attained by the application of this knowledge to the practice of actual flight without the use of any motive power other than that provided by the elements and the dynamic power due to the weight of the machine and its human load.

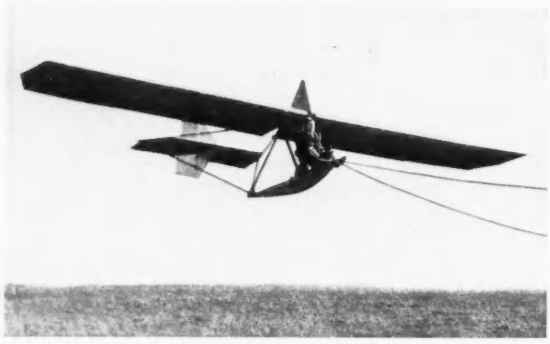
The modern glider and soaring machine, in the opinion of those qualified to know, will fulfil under present conditions the same essential features in our never-ending search for advance in the science of flight. That is the wonderful prospect which this old-new activity opens up.

Why, it will be asked, if this is true, has gliding been thrust into the background and, as far as the present age is concerned, has only appeared since the war? The answer is that once mechanical flight was proved to be practical the whole attention of the aircraft industry was devoted to its development, and the glider was regarded as a step that had served its purpose and completed its period of usefulness. Few, if any, of those connected with aviation twenty-five years ago even contemplated such a development as the modern efficient soaring machine. The war has been directly responsible for the modern development. By the Treaty of Versailles Germany was forbidden for a period of years anything but the most limited development of her aviation possibilities.

So severe were the restrictions that those far-

THE GLIDING COMPETITION.

Some of the sailplanes which took part in the recent International Competition.



THE BEGINNER'S MACHINE.
The type of glider in which pilots train for a "C" certificate.

sighted Germans who have done so much to foster and develop the science in spite of all restrictions saw that unless some legitimate means of avoiding the regulations could be discovered, Germany's youth would be denied the opportunity of taking its place in this greatest of all new industries. It was very soon discovered that the Treaty said nothing about gliders or motorless aircraft of any kind, so with characteristic enterprise they set about organizing a movement which would appeal to the youth of Germany and eventually spread throughout the whole of the nation.

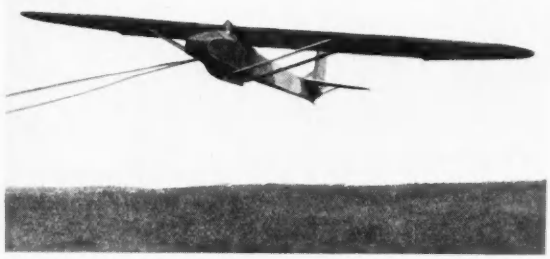
For a couple of years steady progress was made without any marked attention from the outside world, although from time to time rumours and reports stated that almost incredible performances were being obtained at a spot known as the Wasserkuppe in the Rhön Mountains. In 1922 the limelight of publicity was directed to the remarkable results the Germans had obtained. An international competition was organized in the summer of that year by the Royal Aero Club, and in spite of the short notice many British competitors took part and put up creditable performances. A prize for the longest flight was won by M. Maneyrol with a flight of 3 hrs. 21 mins. 7 secs.

After taking stock of the experience gained, the general conclusion was that the next step should be the fitting of a small motor to the gliders and so open up the field of light aeroplanes that would come into almost universal use. There followed two years of development on light aeroplanes but they were before their time, and then the industry changed over to the production of the light aeroplane as we know it to-day. It may be stated that these early efforts led by direct steps to the development of a type of aircraft that has made the British aviation industry famous all over the world. Meanwhile gliding came to a complete standstill in England, but in Germany progress went forward with increasing vigour. The machines became highly developed and some remarkable performances were accomplished, record succeeding record. The huge organization having its heart at the Wasserkuppe had spread all over Germany and received the financial support of the National Government. Most of the German university schools and technical colleges had their gliding clubs where they designed, built and flew machines which were the products of their own technical researches.

In England, in the winter of 1929, a small band of enthusiasts met in London and decided that the time had now come to attempt once more the establishment of the gliding movement upon a permanent basis. It was realized that if the movement was to succeed it was imperative that it should have its own central organization and be self-governed, whereupon it was decided to found the British Gliding Association "to promote, encourage and control gliding in all its forms." Its inaugural meeting was held at the Royal Society of Arts on 27th March, 1930.

The Association had the good fortune to have as its first President the late Sir Sefton Brancker, who had from the very first unbounded faith in the future of the movement. Through his good offices Lord Wakefield, the generous patron of aviation, was readily convinced that practical work of a national character awaited accomplishment and generously made a donation of £1,000 to the funds of the Association, thus enabling an immediate and adequate start to be made in carrying out the objects in view.

The country was ready to receive and accept the movement, and the demonstrations arranged by the B.G.A. and so ably executed by Herr Robert Kronfeld resulted in the formation up and down the country of nearly a hundred gliding clubs by the end of 1930.



GLIDER FOR CLASS "A" PILOTS.
There are 250 British gliders of whom 185 hold "A" certificates.

Unfortunately, the Association had not the funds available to enable it to found even a modest copy of the now famous Wasserkuppe organization, where a month's complete training on a well-organized basis is available to all Germans at the remarkably low fee of 150 marks. This was only possible because of the substantial subsidy received from the German government and grants from other sources.

The British clubs had, in consequence, to start their existence with short funds, inadequate knowledge and a complete lack of practical experience in the running of a club and training its members to fly. Thanks to the assistance most generously given by the German gliding movement through Dr. Georgii and his associates, the B.G.A. was helped in the selection of suitable machines for training, and much useful aid and service has at all times been freely given by Germany on all aspects of the gliding movement.

In spite of this welcome assistance the British clubs had to purchase most of their knowledge in the hard school of experience at the usual high cost, and many are to-day feeling considerably shaken by their first year's experience. But although it was launched in the face of substantial difficulties the movement can look back with considerable satisfaction on the cumulative results. To-day the position in Great Britain can best be summarized in the following statement of facts.

The B.G.A. has an individual membership of 250 and 37 clubs affiliated to it, and the Association, which has had to rely on those interested in the movement for financial support, is able to report that in spite of all difficulties it is solvent. It has been entrusted by the Air Ministry with the sole duty of controlling the safety of the machines and the issue of certificates of airworthiness for gliders and sailplanes. The Royal Aero Club issues pilot's certificates on the recommendations of the official observers of the B.G.A., and in accordance with the regulations of the Federation Aeronautique Internationale. The Royal Aero Club also entrusts the Association with the control of all the sporting events connected with gliding. The B.G.A. produces its own paper, "The Sailplane and Glider," which is published fortnightly. It is the only paper in the world solely devoted to motorless flying. The total number of clubs in the country are approximately 90, with an estimated membership of 50. These clubs are spread all over England, Wales, Scotland and Northern Ireland, the tendency to concentration being in Yorkshire and the Midlands.

A GLIDER IN FLIGHT.

The cross-country record of eight miles was made in a British machine.

The total number of pilots trained to date are 185 "A," 60 "B," and 23 "C." These three classes of certificates represent the three distinct stages in piloting skill. The holding of a "C" certificate indicates that the pilot has demonstrated his ability to carry out sustained soaring flight. There are no less than four manufacturers of sailplanes in Great Britain, and it is estimated that there are 150 gliders and sailplanes in the country at present. Every week-end, and at some places during the week, gliding and soaring flight is practiced by the clubs throughout the country.

During the current year several remarkable achievements have been accomplished: the English Channel has been crossed by sailplane in both directions in one day; the British duration record has been broken on three successive occasions, and stands now at over six hours. The observed cross-country record stands at eight miles, and was made on a machine of British design and manufacture. Several successful British sailplanes have been produced that are well up to the high standard reached by German designers. This

A GERMAN SAILPLANE.

The German machines have become highly developed in recent years.

catalogue of facts gives a clear picture of the rapid growth of a very young movement under difficult conditions. What of the future? How will the gliding movement prove of value in a practical sense and how will it assist the progress of aviation? Before attempting an answer, the following points must be appreciated. Aviation will undoubtedly become the greatest industry of the age because the modern world depends more and more upon swift transport.

Many Aspects.

No nation stands in greater need of a new industry to take the place of those whose heyday has passed than Great Britain, and we should be determined in our efforts to make the aircraft industry ours. To accomplish this it is essential that the nation should have an appreciation and sympathetic understanding of its many aspects, and there should be ingrained in the generation now reaching maturity a proper familiarity with all its phases.

There is no path by which this can be accomplished except through a practical and intimate contact with the science, art and practice of aviation. Unfortunately to-day and in the near future practical aviation must be beyond the reach of the greater number who long to be associated with it because of its high cost. It is here that the glider and sailplane are able to satisfy the ambition of this majority, for it may be said with truth that gliding is within the reach of almost everyone. It will develop all four important sections of aviation to an extraordinary degree.

The scientific and technical side is developed because new types of machines can be evolved, without the interference of the engine and its limiting effect on designs and the burden of cost. The absence of any external motive power shows up at once such defects as are inherent in the design, from the efficiency and control standpoint.

The piloting side can be developed because the cost of training is within the means of all who can aspire to the ownership of a cycle. The cost of training to "C" standard (the highest certificate) should not exceed £10 in the course of a year. Having learned to fly relying solely upon the proper use of the conditions under which the pilot is operating means that a most valuable technique has been acquired which is not possessed by many aeroplane pilots. As far as experience goes it seems to be conclusively established that the average glider pilot who has acquired "C" standard and has done subsequently a reasonable amount of gliding on sailplanes is undoubtedly quick at mastering a power machine, the time required to qualify for the "A" power pilot's certificate being from fifteen minutes to an hour. Thereafter he is a much safer pilot of power machines because he has not been taught to depend on an engine to get him out of difficulty. This means that the cost of flying will be materially reduced.

The manufacturing, operating, and maintenance risk will also benefit because a large number of the coming generation will be trained to the work of building, operating and maintaining machines. The meteorological aspect takes on a new significance for the condition of the air is of the greatest importance to the sailplane pilot. Already much new information has been obtained, particularly in Germany, which is of practical value in the operation of power aircraft.

It is not possible to say at this stage whether gliders can be turned to a commercial end as a means of transport. All that can reasonably be said is that many flights of over a hundred miles as the crow flies have been accomplished, several in weather which the average power pilot would avoid. The record for distance now stands at 166 miles. The height record is 10,000 feet above sea level, and experiments are now being conducted by towing gliders in train fashion behind an aeroplane that becomes an aerial locomotive.

He will be a bold man who at this juncture attempts to define the limitations of the movement; it is surely more profitable to address oneself to the task of turning to the maximum advantage the great possibilities that are waiting development.

Correspondence.

"MAN AND THE DINOSAUR."

To the Editor of DISCOVERY.

SIR,

In the article "Man and the Dinosaur," in the October issue of *Discovery*, it is suggested that the discovery of the remains of *Nothrotherium* in association with objects attributed to primitive man is evidence of the contemporaneous existence of man and members of the great reptile order Dinosauria, but it has apparently been overlooked (a) that far from persisting until the close of the Tertiary Era, the Dinosauria became extinct before it commenced, and (b) that *Nothrotherium* is a mammal and not a reptile.

As a record of evidence pointing to the co-existence of man and the giant ground-sloths, the article has considerable interest, but this is not the first occasion on which such evidence has been forthcoming, for in 1900, on the authority of Dr. W. D. Matthew of the American Museum of Natural History (American Museum *Journal*, Vol. XV, 1915, p. 256), the exploration of a cave in Patagonia "furnished abundant proof that one species at least of these strange animals survived to within a few centuries of the present day, and was not only contemporary with primitive man but was in some sense of the word domesticated by him."

Yours faithfully

F. J. NORTH.

National Museum of Wales.

Book Reviews.

Biology and Mankind. By S. A. McDowall. (Cambridge University Press. 6s.).

The author of this book is a science master in one of our large public schools. His object in writing it is most praiseworthy: he desires to bring home to the general public the bearing of biological laws on the problems with which statesmen have to deal and to elucidate some of the causes of the ills from which we are at present suffering. These weighty matters are dealt with in the two concluding chapters entitled "Inheritance and Social Affairs" and "Heredity and International Relations." With what Mr. McDowall says in these chapters we find little to quarrel. He points out that large families mean a rapid increase in the population, and that the capacity of the world—in spite of the apparent glut in wheat supply—to produce food is limited, and that if population goes on increasing starvation is bound to result. As regards our own land he stresses the fact that so-called "social services" are encouraging the reproduction of the thriftless and incompetent at the expense of the thrifty and making a continuous addition to the burden of taxation.

Mr. McDowall, however, is in error in attributing the large families of the early part of the nineteenth century to the demand for child labour. Miss Buer has shown that the increase in the population of England was due, as is the periodic increase of animal populations, not to an improvement in the birth-rate but to an improvement in the survival rate: that, in fact, the advance of medical science as exemplified in vaccination and the introduction of sanitation caused the survival of an enormous number of children who would otherwise have died young. But the author does not confine himself to pointing out the basal principles of biology, viz., the tendency of population to increase and to produce a struggle for existence, and the fact that strength and ability are inheritable just as are weakness and stupidity and showing how these are as true for human kind as for animals. He endeavours in the earlier part of the book to prove the truth of evolution, to discuss the questions of the inheritability of acquired characters, to endorse Weismann, and to lay down dogmatically so-called precise "laws of heredity." In all these matters his knowledge is obviously second-hand, and he has committed many blunders which must prejudice the causes which he advocates. He voices the views of one narrow and extreme school.

As one example of Mr. McDowall's errors we may take his remarks about Lamarck and the comparison between Lamarck and Darwin. He says correctly that Lamarck introduced the first theory of organic evolution—viz., the inheritance of acquired characters, but he says that Lamarck gave no facts to support it and that it was merely a brilliant guess based on a "superficial probability." The outstanding difficulty, he says, about this theory is to explain how an alteration in one organ could so impress itself on the organism that the germ cell would reproduce the same alteration in the next generation. Darwin's theory, he holds, was supported by a great mass of facts. Such a statement is not only a complete travesty of the case but affords evidence that Mr. McDowall has never read Lamarck's works. Lamarck was one of the greatest biologists of all time. In ten years he created the science of invertebrate zoology and laid the foundation of a classification which in its main outlines has endured to the present time. Darwin, who was not a biologist but a country gentleman and a field naturalist, produced a great deal more detailed evidence in favour of the actual occurrence of evolution of the same kind as that produced by Lamarck. On the causes of evolution his contribution was a mere formula that more young were born than could survive.

In conclusion we might remind Mr. McDowall of what is meant by an "acquired character": it is not, as he supposes, an alteration in one organ which must somehow be represented in the germ-cell: it is a *habit*. A habit is not an alteration in one organ, it is a reaction of the animal as a whole—and that acquired habits are inheritable we have now definite experimental proof. It is deplorable that an educationalist should so misread a doctrine which, when finally accepted, will glorify and widen the outlook of the profession of teaching.

Makers of Europe. By Robert Seymour Conway. (Humphrey Milford. 6s.).

The matter contained in this short book was delivered as the 1930 series of the James Henry Morgan Lectures in Dickinson College. In it the author again turns the light of his erudition upon four of his great Romans: Caesar, Cicero, Horace and Vergil. Few scholars or general readers would hesitate long to open a new book by Professor Conway on such a subject, even though they might be tempted to reflect (and there could be no greater testimony to the impression that the author has made upon his generation) that they know in advance more or less what to expect. It is, therefore, all the more agreeable in one sense to find that it is a new aspect of these men that Professor Conway reveals. He reveals it with his usual vigour of style, clarity of exposition and incisiveness of judgment. His object is "not to relate history, but only to make clear how its course was changed by certain great men, and especially by their more personal characteristics."

The title "Makers of Europe" hardly suggests the real interest of the book. In passing it seems good to quote against the author the first half dozen words of his work: "Makers of Europe. 1. Caesar the Destroyer." After thus paradoxically parading his first maker as a destroyer, the author proceeds to do a little destroying on his own account. At least it will not be his fault if any of those who heard his lectures or now read his book, retain any faith in Mommsen as a guide to the character of Julius Caesar. Professor Conway's case is both irresistible and valuable; but his polemics, vigorous, exciting and necessary as they are, are never as good or as exciting as his enthusiasms. Moreover, his enthusiasms are themselves most exhilarating to his readers and to his students when his approach to them is ancient, not modern. The best one has yet received from the author's fruitful mind has been when he has explained the meaning and derivation of simple, familiar words: or words one thought familiar until he invested them with unsuspected values; or when he has clarified and explored the fullness of poetic meaning in, say, Vergil. To listen to him on such a subject is to receive the same sort of thrill that one receives on seeing Duleepsinghi cut or Ernest Tyldesley pull, or Professor Conway's own son swerve majestically and electrically; they are masters in their field. Probably because of one's appreciation of the author's pure scholarship one has to confess that he is less like himself when he spans the centuries between Cicero and Mill, or deserts poetry for politics.

There is much of politics in this book. What Professor Conway has to say is interesting in itself and is made as interesting as it intrinsically could be by the lively vehicle of the

author's mind; but politics in any age, in any circumstances, are a drab and depressing business. The Roman politics of the first century B.C. were the same old vulgar muddle they are to-day in any country, and such minds as Cicero's, Horace's, even Vergil's, made little difference to the abiding courses of mob activity. The climax of political vulgarity in all ages and in all countries is probably expressed by the famous silly saying, "dulce et decorum est pro patria mori." Professor Conway will be hurt: yet his complete innocence of any taint of cynicism is probably one of the qualities that makes of him an artist in his particular field, the field of philology and Roman poetry. Even in the present book, which has a big political element in it, the author, no doubt unconsciously, now and then escapes into pure poetry and gives us his best. Of course, the book is a valuable contribution to knowledge on the personal aspect of his four men as men of affairs. He throws typically new and voluminous light on Horace's Fourteenth Ode of Book I. He gives a devastatingly vivid revelation of Caesar's character: brutal, thorough, humourless, courageous and "a gentleman," and affords typically profound evidence for assessing the political influence of the other three. Altogether an eminently readable and valuable book; but one would rather the Conway of pure scholarship.

The Standard Natural History. From Amoeba to Man. Edited by W. P. Pycraft. (Warne. 15*s*.).

Zoology, with its myriad workers in all countries, advances rapidly on a wide front. Thus there is need for a summary restatement of recorded knowledge every few years. Nothing better of the kind could be provided for the average reader who is interested in the subject—and surely every intelligent person comes in that category—than the new volume edited by Mr Pycraft and written by himself and his colleagues at the Natural History Museum, South Kensington. It is a handsome quarto, well printed, lavishly and thoughtfully illustrated with photographs and coloured plates, and convenient to hold and to read, despite its thousand pages. The book is planned as usual on the evolutionary principle, beginning with protozoa and ending with anthropoids, and taking the simplest forms first in each class with sufficient reference to archaic or extinct species. Each class or section is treated by a well-known specialist. The Editor writes admirably on birds in some two hundred pages. Mr. N. D. Riley deals with butterflies and moths, and Dr. F. W. Edwards with flies, gnats and midges. Mr. J. K. Norman contributes the section on fishes, Mr. H. W. Parker the chapter on reptiles, and Mr. J. G. Dollman the important final section on mammals. Throughout the text is both scholarly and interesting. The authors do not fear to introduce these little digressions which attract the ordinary layman and help to fix the zoological details in his mind. Thus we are told that butterflies of the genus *Cephenomyia* can fly at a speed of six hundred miles an hour and outstrip even Flight-Lieutenant Stainforth in his Schneider Trophy seaplane. "The Chromid of the Lake of Galilee is said to have formed part of the miraculous draught of fishes recorded in the Gospels, and a black spot on its side is said to commemorate the touch of St. Peter"—a legend that has been transferred in Cornwall to the mackerel. The belief that the sword-fish uses its formidable snout as a weapon of attack is said to be very questionable. The reprehensible habit of the cuckoo, in using other birds' nests instead of building her own, is tentatively ascribed to the fact that male cuckoos greatly outnumber the females who thus are too fully occupied with their successive mates to trouble about nests. Such notes, scattered up and down the book, add very greatly to its interest, and show that the authors are concerned to make it popular in the best sense of the word. They are to be congratulated, one and all, on their clear and simple style. The photographs are well chosen and well printed, the twelve coloured plates, especially that of the fishes, are attractive, and there is a really full and accurate index. The book is assured of success.

Celluloid: The Film To-day. By Paul Rotha. (Longmans. 7*s*. 6*d*.).

Mr. Rotha caters for a public which is nearly as new as the "talkie" and whose interests have been almost entirely neglected. This is not a book for the fan; his requirements are amply served elsewhere. Like the author's previous book, "The Film Till Now," this is essentially a book for those who, with Mr. Rotha, realize the supreme importance of the film in industry and social life as well as in entertainment. To the author, the cinema is simply a method of expression admirably suited to the needs of present-day argument. "It is a means of propaganda, either in a fictional way or as a specifically designed piece of advertisement. It is a medium which offers to any creative mind a wealth of experiment in its peculiar technical devices for appealing to the human beings of this world." The remarkable magnetism which exists between the screen and the audience is a source of perpetual interest to the author. By analysis of every film he has seen, he has endeavoured to fathom the constitution and the strength of this appeal between a projected film and its audience. "It is obvious that in this secret lies the key to entertainment from a cultural, aesthetic and box-office point of view."

The many problems with which the film producers are faced are tackled one by one, and if Mr. Rotha's conclusions are not always optimistic, he treats the subject with thoroughness and with scrupulous fairness. Unlike most of the critics, he is not afraid to say that the conditions under which the majority of British films are produced are intolerable, and that no individual with the sort of intelligence and energy so urgently wanted in the film trade will now accept a post in the British film industry. On the other hand, Mr. Rotha is fully alive to the limitations of the Hollywood product, and is not of the so-called intelligentsia, among whom it is fashionable only to praise the products of Russia and France.

The extent to which the film is employed, directly and otherwise, as propaganda, may not be generally realized. "Under the thin veil of entertainment, the hard fact is apparent that the film is the most influential medium yet discovered for persuading the audience to believe this or to do that." In the American cinema such notable films as "The Big Parade" and "All Quiet on the Western Front" are at heart propagandist in aim, and it is interesting to note that the film "Nanook of the North" was sponsored by a fur company as incidental propaganda. "The King of Jazz" is to all intents and purposes straightforward advertisement of American dance tunes, while "The Silver Horde" was financed as publicity by the Icy Point Salmon Company of Alaska. "The tremendous impetus behind the American film to-day is largely brought about by the wishes of Wall Street, the virtual controllers of policy in Hollywood. After a recent trade depression orders were issued to Hollywood from Wall Street that films scheduled for this year's production should be set against an industrial or agricultural environment, in an attempt to strengthen general

industrial and agricultural conditions in America." Incidentally the sum allotted for production in Hollywood this year is said to be in the neighbourhood of forty million pounds. "It is obvious that the Americans consider this indirect method of advertising, by familiarizing their public with the interior of factories and the workings of big industrial concerns, to be the most valuable stimulant to trade."

A Practical Handbook of Water Supply. By FRANK DIXEY. (Murby. 21s.).

The title of this book does not adequately indicate its scope, for in addition to an account of the general principles of water supply, it deals very fully with a special aspect of the subject, namely that relating to water finding and water conservation in tropical countries, and especially in Africa, where the author, who is Director of the Geological Survey, Nyasaland, has spent the greater part of his working life.

The first chapter deals with some of the water problems, political, economic and social, that confront the inhabitants of tropical countries, and with the ways in which the local water supplies are modified, usually in an adverse sense, by the uncontrolled destruction of forests and by the more legitimate activities of the settler. The author's observations relating to the disastrous results following upon the indiscriminate destruction of forests are important. In Africa the clearance of the bush to provide land for cultivation has resulted in soil erosion, the exposure of bare rock surfaces, the distribution of silt in the lower courses of rivers and the scouring of their upper courses, all of which, together with other factors, lead to a general impairment of the economic value of the water even although the total rainfall may not have been seriously affected. Succeeding chapters deal with surface water and the means by which it can be conserved, whether the quantity is small enough to be stored in a tank or large enough to require the impounding of a reservoir; the origin of well water and the sinking of wells; the methods for testing water, for its purification and for safeguarding sources of supply; the general principles of water finding; and the condition of water supply in Southern, Central, and Eastern Africa.

This is essentially a book of practice, for although the principles governing the distribution and mode of occurrence of water are sufficiently well dealt with, by far the greater part of its pages are concerned with the actual work that has to be done when the maintenace of a water supply is desired. In addition to those for whose special benefit the book was prepared, the student of geology and the civil engineer, especially the former, will find much of interest in its pages, while here and there are passages of importance to the student of forestry. The water diviner is, as one would expect, a familiar feature in regions such as that in which the author gained his experience, and it is interesting to read: "From my own experience of diviners of water supply I am satisfied that in most cases . . . the diviner himself unconsciously moves the rod because he has subconsciously formed the opinion as a result of former experience or otherwise that water exists at the place indicated."

Tribal Studies in Northern Nigeria. Vol. II. By C. K. MEEK. (Kegan Paul. 25s.).

It requires a book such as this to bring home to a majority of the British public the immense responsibility we have taken on our shoulders in the government of Nigeria. This is not a mere matter of area and numbers, though both are vast. One tribe alone with which the author deals in this volume numbers over twenty-two thousand. It is rather the enormous range in variety of custom and belief which throws a heavy burden on the administration. For Nigeria has adopted the system of "indirect rule"; and government through native institutions, which is the essence of that system, requires of necessity a knowledge of what those institutions are and what they imply. Only a very brief acquaintance with the working of the native mind is needed to bring out the fact that the implications of a custom are often vastly more far-reaching than its mere face-value would suggest. Hence the unexpected difficulties which arise from well-meaning attempts to suppress customs repugnant to European ideas.

The subject of marriage comes inevitably to the fore in dealing with this book, for it is one of the most important sections in each account of the various tribes. At the same time it is one of the most interesting from the point of view of comparative study. Here, for instance, we find marriage by capture, which has at one time or another been derided as an illusion of the theorist, actually in process of development into something different. Among the Katab of the Plateau and Zaria Provinces there are three forms of marriage. Of these, one is with an unmarried girl by payment to her parents, but formerly she was stolen or eloped before compensation was payable; the second, the most characteristic feature of Katab custom, is by elopement with a married woman, the parents receiving payment from the gallant who carries her off. One lady may have favoured as many as ten husbands in this way, though in that event her conduct would be regarded as light. On the other hand, parents who encouraged their daughter to such excess, having in view the compensation payable, would be regarded with contempt. The implication as to how such encouragement would be regarded were restraint exercised as to number, is obvious. Though the British Government discourages such marriages, Mr. Meek considers it would be unwise to forbid them without careful consideration of the consequences.

It is difficult to refrain from comment on, or from quoting parallels to, the many interesting customs which the author records—as, for example, the priest-kings, the development of the chieftainship and its relation to the religious headship of the group. Enough has been said to indicate that this book will be treasure trove to the student of custom and belief as well as to those who delight in the "devices of the heathen."

Bird and Other Nature Problems. By T. A. COWARD. (Warne. 7s. 6d.).

Mr. Coward's latest book covers an immense amount of ground; it is full of stimulating thought and close observation. Perhaps the most interesting chapters are those on "the Mind of the Bird" and "the Mind of the Insect." The author's views are sane. "The bird's thoughts are the thoughts of a bird, not of a man; they may be similar to ours, but we do not know"—a truth often forgotten by anthropomorphic writers. And, again, "the actual working of a bird's mind remains a closed book, yet we may safely conclude that though some actions are purely instinctive, others indicate a glimmering of thought which cannot be distinguished from reason." As in another passage Mr. Coward uses "reason" and "intelligence" synonymously, we assume that here "reason" is used in the popular sense, and not in its technical sense, connoting

the power to conceive a plan or form a mental image. The instances quoted seem to prove "intelligence," *i.e.*, the power of putting two and two together, but this, though more than "instinct," is not "reason." With insects the position is even more debatable, but here too we seem to find, in the earwig for instance, something very near "intelligent" behaviour. In a chapter on "Bluff" the author relates instances of dotterel and golden plover feigning death; this trick is not, of course, confined to birds; a fox will sham death. But whether this is always conscious action or not Mr. Coward considers to be doubtful.

He tells us that he was once sceptical as to trans-Atlantic migration, but even before the record of a British-ringed lapwing recovered in Newfoundland settled the question, he was converted to the belief that it was not only possible but repeatedly undertaken. In December 1927 hundreds of lapwings (which are not American birds) reached Newfoundland. Mr. Coward thinks that, travelling in an air current which greatly accelerated their normal flight, they unconsciously passed beyond Ireland, and so crossed the ocean. Adding the gale's speed of forty to fifty miles an hour to the lapwing's ordinary speed, which is about forty, they would cover the distance in under twenty-four hours. Discussing orientation in vertebrates and in insects, he says, "we see in a variety of animals apparent evidence of a power of orientation distinct from previous experience." In some insects this sense becomes a force which drives them to destruction. They are governed by a "biological law which demands immense sacrifice of superfluous life in order to produce the fittest to survive." On the thorny subject of bird-protection, Mr. Coward points out that it will never really be effective until the law has a stronger public opinion behind it. "Our hope is with young, the growing generations."

The book also includes thoughtful dissertations on the crossbill, the squirrel problem, the real bird, and bird-marking (*i.e.*, ringing); accounts of visits to Scolt Head, the Hungarian Marshes, a voyage up the Danube, sketches of the English countryside and its denizens in midwinter and summer, and a chapter on sheep, in which the author pungently compares the mentality of human followers of fashion and convention, both female and male, with that of those blindly imitative animals. In a chapter on the starling Mr. Coward suggests that its increase may be checked by its wasteful habit of egg-dropping.

A Naturalist in Brazil. By KONRAD GÜNTHER. Translated by BERNARD MIALL. (Allen & Unwin. 25*s*.).

Professor Günther of Freiburg went to Brazil a few years ago to report on the plague of insects in the cotton plantations of Pernambuco. He stayed a year in various parts of the country and studied its natural history as a whole. In this excellent book, which is well translated, Professor Günther describes the Brazilian fauna and flora and appends some friendly comments on the Brazilian people and their kindly and hospitable ways. He is a keen observer and abounds in information without being dull. Throughout he is impressed with the balance that nature maintains between the species. He explains clearly how special flowers are adapted to special insects which fertilize them. He gives many examples of protective mimicry. He shows that in the northern cotton fields, which are very large, nature's balance has been disturbed by the disappearance of the woods in extensive areas, with the result that the birds have gone elsewhere and no longer prey on the insects that damage the cotton crop. He is very doubtful of the wisdom of importing even alien trees, not to say alien creatures, into a country. In Brazil, he thinks, the Australian eucalyptus is out of place, if not definitely harmful. He would have the Government control the rate at which the virgin forest is being destroyed lest nature's balance should be thrown out of gear. Professor Günther notes many interesting details. Two may be mentioned. The old theory that parrots so often have green plumage because it blends with the foliage and thus protects them is contradicted: the grass-green parrots stand out clearly against the darker green of the leaves. The existence of vampire bats, which suck the blood of a man or a horse, is definitely established, but such creatures are not common. In disproof of the belief that tropical birds do not sing, the author has a whole chapter on "The Symphony of Voices," in which the birds play no small part. On the marvellous beauty of the birds and butterflies Professor Günther is truly eloquent. His book, with its many engaging photographs, will certainly make the reader wish to visit Brazil.

Flying Dutchman. The Life of Fokker. By ANTHONY FOKKER and BRUCE GOULD. (Routledge. 6*s*.).

Fortunately, the name of Fokker no longer has the unpleasant significance of war days, although it will always call to mind the amazing feats of the German aces over the Western Front in the latter years of the war. Anthony Fokker was the son of a Dutch coffee planter and was born in the Java jungle. At an early age he returned to Holland with his family to complete his education, but like many great men, and most inventors, his record at school was a bad one. He excelled in manual training, however, and had his own workshop, always "going at full blast," in an attic at home. Fokker's first invention was a "flop." He and a friend had spent months in perfecting an unpuncturable motor tyre when a French patent which antedated their own was discovered. This was the least of many setbacks which the young inventor encountered before the Germans took up his aeroplane in 1913, and "before I knew it, German airmen were winning victories in Fokker flyers over the Western Front."

With the help of Mr. Bruce Gould, Fokker relates the story of his eventful career in this fascinating book—his early experiments, the first flight in his home town which so nearly ended in disaster, his adventures at the flying school, the coming of the war and the invention of the synchronized machine gun, the carefully laid plot by which 360 railway trucks loaded with aeroplanes, engines and parts were smuggled out of Germany into Holland without the knowledge of the government. It is an absorbing story, thoroughly but modestly told. There are many interesting photographs.

Marsh and Mudflat. By KENNETH DAWSON. Illustrated by WINIFRED AUSTIN. (Country Life. 15*s*.).

Major Dawson's reminiscences of wildfowling are probably too exclusively sporting in interest to attract the general reader, but Miss Winifred Austin's drypoints and etchings are well worth the modest price of the book. Some of the chapters are entitled, "A Wildfowler's Paradise," "Wild Goose Driving," "An Evening in Macedonia"; and even those who, like the reviewer, are not entertained by accounts of shooting, will agree that the author's style is a distinct improvement on the class of descriptive writing usually adopted by sportsmen.

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